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CONNORS BROS., LIMITED Black's Harbour, New Brunswick, E0G 1H0, Canada

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FISH PACKING PLANT N.B. 36

ENERGY MANAGEMENT PROJECT

CONNORS BROTHERS LTD.

Blacks Harbour, N.B.

December, 1984

CREDA Project 2032

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Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

Conservation & Renewable
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Fredericton, N.B.
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Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables

Le Programme de démonstration des économies d'énergie et des énergies renouvelables est administré au Nouveau-Brunswick par le Secrétariat à l'énergie, en collaboration avec Energie, Mines et Ressources Canada. Ce programme tente d'abord de vérifier la fiabilité des techniques de conservation d'énergie, d'accroître la sensibilité du public envers ces techniques et, enfin, de favoriser la création d'emplois au sein des industries nouvelles ou déjà existantes.

Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

Division des économies d'énergie
et des énergies renouvelables
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D I S C L A I M E R

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D E N I D E R E S P O N S A B I L I T E

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EXECUTIVE SUMMARY

This is the final report on the Energy Management System project completed at Connors Bros., Limited's #10 Sardine Plant in Blacks Harbour, N. B.. In order to further reduce energy usage Connors Bros., Limited felt the need for more sophisticated means of monitoring major potential energy waste areas.

On December 7, 1981 an application was forwarded to the N.B. Energy Secretariat's office requesting financial assistance under their Conservation and Renewable Energy Demonstration Program (CREDA). The assistance was to demonstrate the potential energy savings in fish plants such as Connors Bros., Limited of Blacks Harbour through heat recovery and improved energy management. The application was approved for a 71% grant and the project installed between March 1, 1982 and Oct. 1, 1983. Since Oct. 1, 1983 the project has been monitored.

The technologies to be demonstrated were combined into one integrated energy management system. The system was based on automatic monitoring and controlling of energy usage with the use of a Programmable Controller and microcomputer. The technologies demonstrated included:

a) Heat recovered from hot air sources in the plant.
b) Heat recovered from hot waste water.
c) Load management of electrical equipment.
d) Monitoring and control of the system using a programmable controller.
e) Analysis and system performance evaluation using a microcomputer.

Chapters 2-6 deal with a description of what was done in demonstrating each of these 5 technologies.

Monitoring the performance of the system began on October 1/83. System performance, as indicated by a combination of observed measurements and theoretical calculations, is detailed in Chapter 7 and summarized below:

A. Savings

	AREA	SAVINGS	CAPITAL COST
1.	Hot Air Recovery	$ 29,052	$ 18,000
2.	Hot Water Recovery:		
	a) - Can Washers	17,934	8,000
	b) - Refrigeration	4,035	15,000
	c) - Tank	7,740	17,000
	d) - SUB-TOTAL	$ 29,709	$ 40,000
3.	Electrical Load Management:		
	a) Power Factor	$ 5,453	
	b) Peak Load Shedding	13,470	
	c) Air Compressor Cycling	1,788	
	d) SUB-TOTAL	$ 20,711	
B.	Capital Cost - Other		
4.	Monitor & Control		40,000
5.	Programmable Controller		50,000
6.	Design & Engineering		11,000
7.	Reports & Demonstration		23,000
8.	Computer Interface		20,000
C.	TOTAL	$ 79,472	$ 202,000

A summary of the capital costs as outlined in Chapter 9 is also included in the above table. Connors Bros., Limited designed and installed entire system.

Chapter 10 presents the Information Transfer activities undertaken.

In conclusion:

1. The project was economically successful. Savings of $79,472 were achieved with a capital cost of $ 202,000 giving a payback of 2.5 years. In addition, this capital cost was higher than required as this was a demonstration project.
2. The technologies to be demonstrated were done so quite successfully.

The recommendations are:

1. General:

Any of these technologies demonstrated may be implemented individually or in groups. They also apply to industries other than the fishing industry.

2. Connors:

   1. Monitoring of the project. More complete measurements of system performance are required to more accurately assess the savings achieved.
   2. Extend work already started to investigate further energy conservation possibilities in the plant.

Sommaire-Recommandation

Voici le rapport final sur le projet de gestion de l'énergie mis en oeuvre à l'usine de sardines numéro dix de Connors Bros., Ltd., à Blacks Harbour (N.-B.). Dans le but de réduire davantage l'utilisation de l'énergie, Connors Bros., Ltd. a jugé nécessaire de faire appel à des moyens plus sophistiqués pour contrôler les principales causes potentielles de pertes énergétiques .

Le 7 décembre 1981, une demande était transmise au Secrétariat à l'énergie du Nouveau-Brunswick pour demander une assistance financière en vertu du Programmme de démonstration des économies d'énergie et des énergies renouvelables (ADEEER). Le projet visé avait pour but de démontrer les économies d'énergie potentielles dans les usines de transformation du poisson comme celles de la Connors Bros., Limited, de Blacks Harbour, au moyen de la récupération de la chaleur et d'une meilleure gestion de l'énergie. La demande de subvention était approuvée pour une participation à 71 % des dépenses et le projet était mis en place entre le ler mars 1982 et le ler octobre 1983. Depuis cette date, l'installation a donné lieu à une surveillance technique.

Les technologies à démontrer ont été combinées dans un système intégré de gestion de l'énergie. A la base du système, on retrouve un dispositif de surveillance et de contrôle automatique de l'utilisation de l'énergie qui est branché à un micro- processeur et un organe de contrôle programmable. Les technologies ainsi démontrées sont les suivantes

a) La récupération de chaleur des sources d'air chaud dans l'usine;
b) La récupération de chaleur des eaux chaudes résiduelles
c) La gestion de la charge du matériel électrique
d) La surveillance et le contrôle du système à l'aide d'un organe de contrôle programmable.
e) L'analyse et l'évaluation du rendement du système à l'aide d'un micro-processeur.

Les chapitres 2 à 6 font la description de ce qui a été réalisé pour démontrer chacune de ces cinq technologies .

La surveillance du rendement du système a débuté le ler octobre 1983, comme il est indiqué au chapitre 7. Le rendement du système, selon l'évaluation obtenue par une combinaison de mesures observées et de calculs théoriques, est présenté sommairement plus loin et plus en détail au chapitre 7.

Sommaire- recommandations (suite)

Economies

SECTEUR	ECONOMIES	COUT DE L'INVESTISSEMENT
1. Récupération de l'air chaud	29 052 $	18 000 $
2. Récupération de l'eau chaude:		
a) - Laveuses de boîtes	17 934	8 000
b) - Réfrigération	4 035	15 000
c) - Réservoir	7 740	17 000
	29 709 $	40 000 $
3. Gestion de la charge électrique:		
a) La puissance	5 453 $	
b) Répartition de la charge de pointe	13 470	
c) Réglage du cycle du compresseur d'air	1 788	
d) SOUS-TOTAL	20 711 $	
B. Coût de l'investissement- Autre		
4. Surveillance et contrôle		40 000 $
5. Organe de contrôle programmable		50 000
6. Conception et étude technique		11 000
7. Rapports et démonstration		23 000
8. Interface de l'ordinateur		20 000
C. TOTAL	79 472 $	202 000 $

Le tableau ci-dessus donne également un relevé sommaire des coûts d'investissement qui sont décrits au chapitre 9. Connors Bros., Limited a conçu et installé l'ensemble du système.

Le chapitre 10 présente les activités de transfert de l'information qui ont été réalisées.

En conclusion:

1. Le projet a été un succès du point de vue économique. En effet, on a réalisé des économies de 79 472 $ avec un investissement de 202 000 $, soit un recouvrement de 2,5 ans. En outre, cet investissement était plus élevé que requis puisqu'il s'agissait d'un projet de démonstration.
2. Les technologies à démontrer ont donc été l'objet d'un assez grand succès.

Voici les recommandations:

1. Généralités:
   N'importe laquelle des technologies démontrées peut être mise en oeuvre individuellement ou en groupe. Elles peuvent également être appliquées à des industries autre que l'industrie des pêches.
2. Connors:
   1. Surveillance du projet. Il serait nécessaire d'obtenir un calcul plus complet du rendement du système afin de mieux évaluer les économies obtenues.
   2. Il faudrait poursuivre le travail déjà entrepris pour évaluer d'autres possibilités d'économie de l'énergie dans l'usine.

I. INTRODUCTION

1. Object:

The object of this report is to present the final report on the Energy Management System project completed at Connors Bros., Limited's #10 Plant in Blacks Harbour, N.B.

2. Background:

Connors Bros., Limited is the largest canner of sardines in North America. Its largest plant (No. 10 Plant) is situated in Blacks Harbour, N.B. The energy cost at No. 10 Plant is approximately $600,000 per year of which approximately 50% is electrical power cost and 50% is fuel oil cost.

Energy conservation measures at this plant have reduced its fuel usage by 40% since 1978. In order to further reduce energy usage Connors Bros., Limited felt the need for more sophisticated means of monitoring major potential energy waste areas and installing additional energy saving equipment.

3. History:

a) On December 7, 1981 an application was forwarded to the N.B. Energy Secretariat's office requesting financial assistance under their Conservation and Renewable Energy Demonstration program (CREDA). The assistance was to demonstrate the potential energy savings in fish plants such as Connors Bros., Limited of Blacks Harbour through heat recovery and improved energy management.

b) A letter of approval was received on January 28, 1982.

c) The contract was signed on April 22, 1982.

d) March 1/82 - October 1/83: Project installed.

e) October 1/83 - March 31/84: Project monitored.

4. The Project:

Connors Bros., Limited received a 71% grant from the Federal and Provincial (N.B.) government Conservation & Renewable Energy Demonstration Agreement (CREDA) to demonstrate several potential energy savings technologies in the area of heat recovery. The technologies were combined into one integrated energy management system. The system was based on automatic monitoring and controlling of energy usage with the use of a programmable controller and a microcomputer.

The technologies demonstrated include:

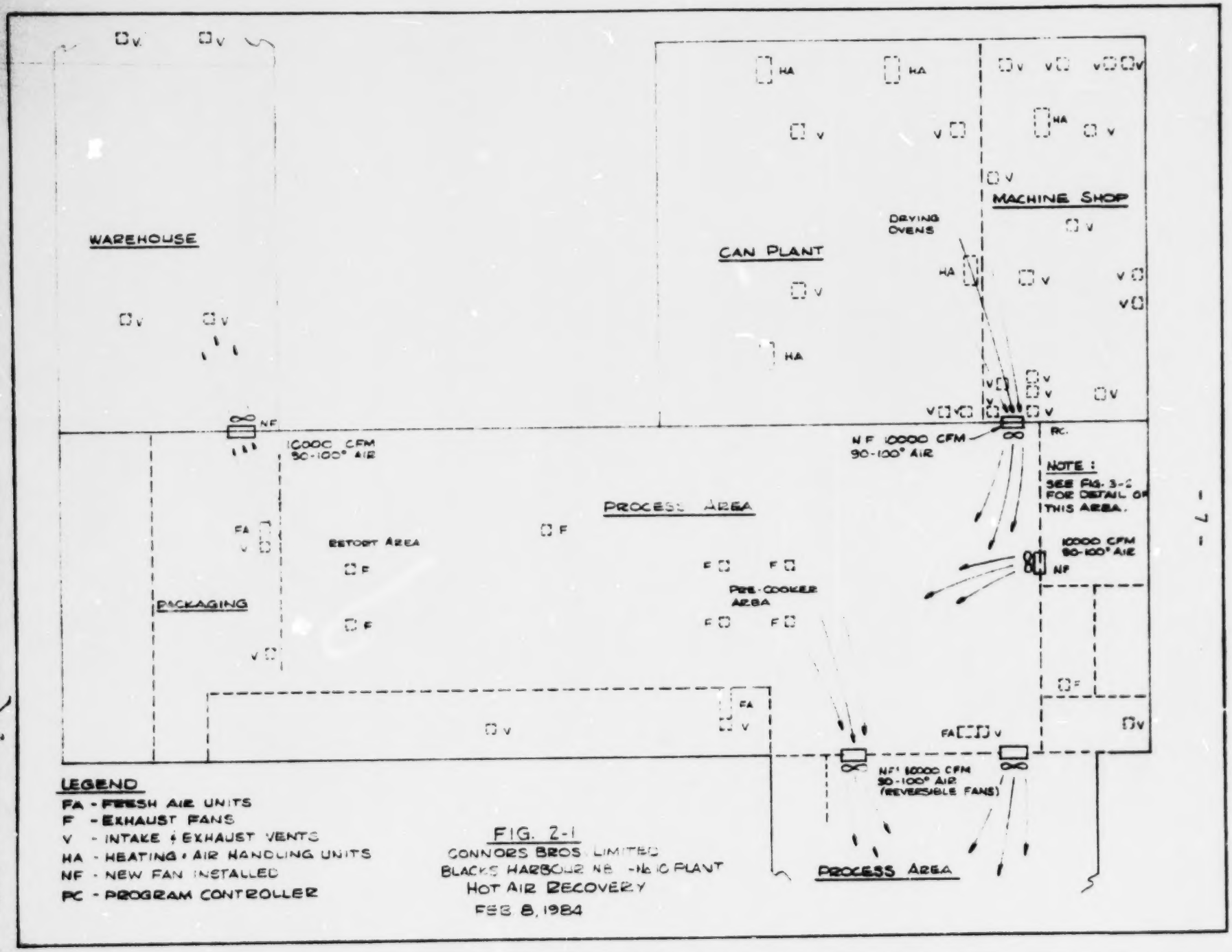
1. Heat recovered from hot air sources in the plant.
2. Heat recovered from hot waste water.
3. Load management of electrical equipment.
4. Monitoring and control of the system using a programmable controller.
5. Analysis and system performance evaluation using a micro-computer.

The next 5 chapters deal with a description of what was done in demonstrating each of these technologies.

II. HOT AIR RECOVERY

Approximately 20,000 cubic feet per minute (cfm) of hot air was being exhausted from the plant. Approximately 12,000 cfm is now being recovered using five wall fans. These fans transfer excess hot air from warm areas to heat cooler plant areas. The fans are individually controlled by an Allen-Bradley Programmable Logic Controller (PLC). The programmable controller uses area temperature readings as its control parameter.

This hot air directly replaces cold make-up air previously supplied to these areas and therefore reduces heating requirements. The layout of this system is shown in Figure 2-1. Detailed description of this system is found in Appendix 1.



LEGEND

FA - FRESH AIR UNITS
F - EXHAUST FANS
V - INTAKE & EXHAUST VENTS
HA - HEATING & AIR HANDLING UNITS
NF - NEW FAN INSTALLED
PC - PROGRAM CONTROLLER

FIG. 2-1
CONNORS BROS LIMITED
BLACKS HARBOUR NB - N& C PLANT
HOT AIR RECOVERY
FEB 8, 1984

III. WASTE WATER HEAT RECOVERY

1. Summary:

There are five major sources of waste heat in the form of hot water in the plant. These are as follows:

- Air compressors (cooling water).
- Boiler continuous blow-down (condensate).
- Refrigeration system heat exchanger (from hot gases; ammonia).
- Boiler oil preheaters (condensate).
- Can washer.

The clean hot water recovered from the air compressors, continuous blowdown and oil preheater is channelled to an insulated 5,000 gallon steel tank for storage and future use in the plant clean up system. The water from the refrigeration system heat exchanger is primarily used for boiler make-up water, otherwise it is channelled to the storage tank. The heat recovered from the can washer is transferred directly to its own make-up water via heat exchanger. This is best depicted in Figure 3-1 (Schematic Diagram) and Figure 3-2 (Plant Layout).

The tank temperature is monitored using the PLC to determine the system's effectiveness.

2. High Pressure Clean-Up System:

The hot water is accumulated during production time, usually during the day, in the storage tank to be used by the night cleaning operation.

A 450 gallon per minute (gpm) pump was installed on the discharge line of the waste heat recovery tank to equalize the tank temperature by continuously recirculating the water and to boost the discharge pressure to a usable level.

Normally, water required in high pressure cleaning system was delivered at 10 C and heated to 52 C. The recovered water is approximately 36 C.

3. Can Washers:

A plate heat exchanger was installed on the discharge of three (3) can washers. The discharged 60 C contaminated water flows from the can washers to a booster pump then through the heat exchanger to the sewer. The 10 C supply of fresh make-up water flows through the secondary circuit of the heat exchanger on its way to the can washers. These can washers use approximately 30 gals/min. of 55 C water. The heat exchanger raises the make-up water from 10 C to 55 C at 20 gallons per minute. The heat exchanger flow rate has been increased to 20 gallons per minute which has been achieved by increasing the pressure on the circulating water.

4. Boiler Make-Up Water:

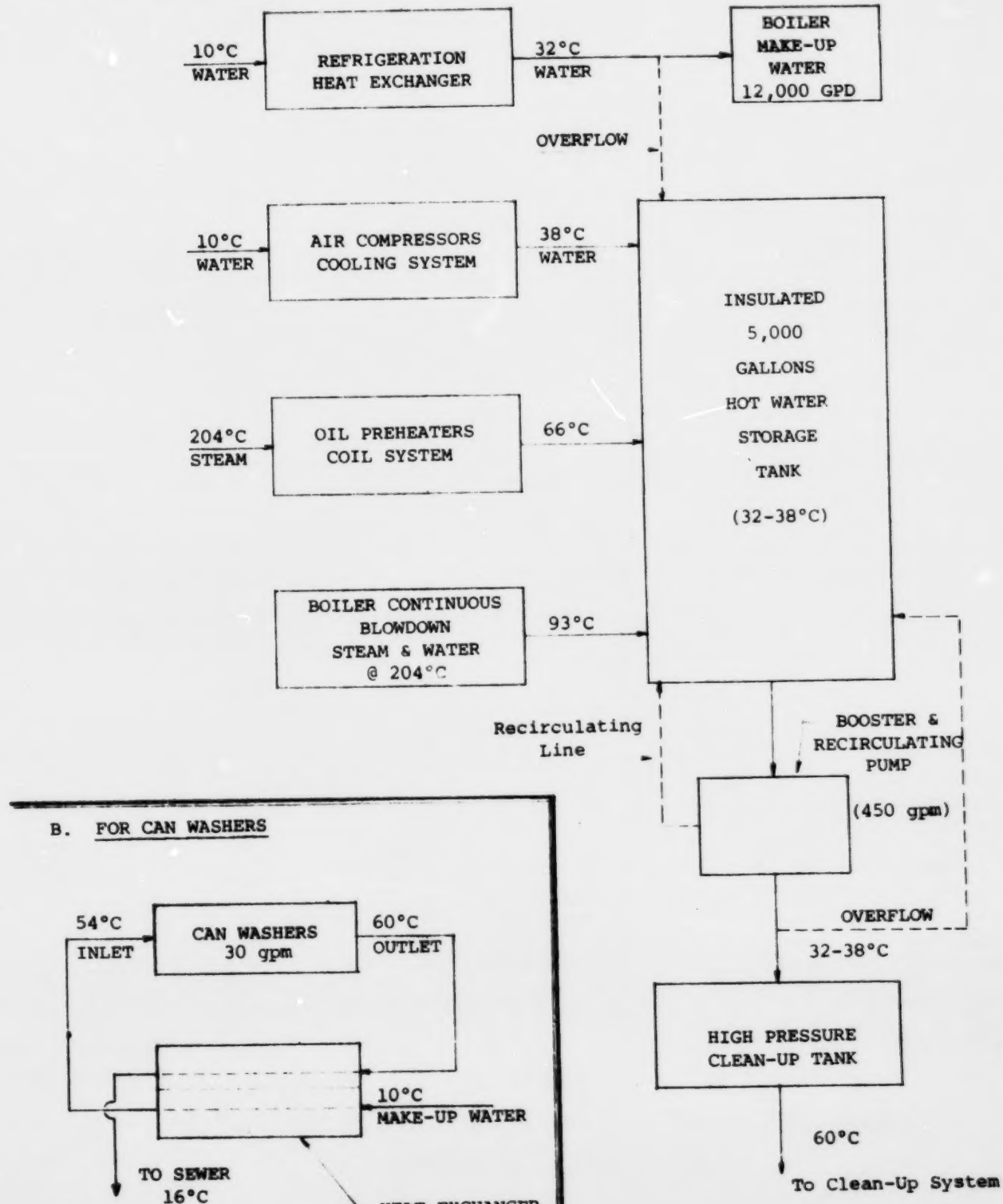
Approximately 12,000 gals/day of make-up water is used for the boiler operation. Normally make-up water was delivered at 10 C.

Heat exchangers installed on hot gas line from the refrigeration system heat the boiler make-up water from 10 C to 32 C. Surplus water goes to the storage tank used for high pressure clean-up.

FIGURE 3-1

SCHEMATIC DIAGRAM OF HOT WATER RECOVERY SYSTEM

A. FOR HIGH PRESSURE CLEAN-UP



B. FOR CAN WASHERS

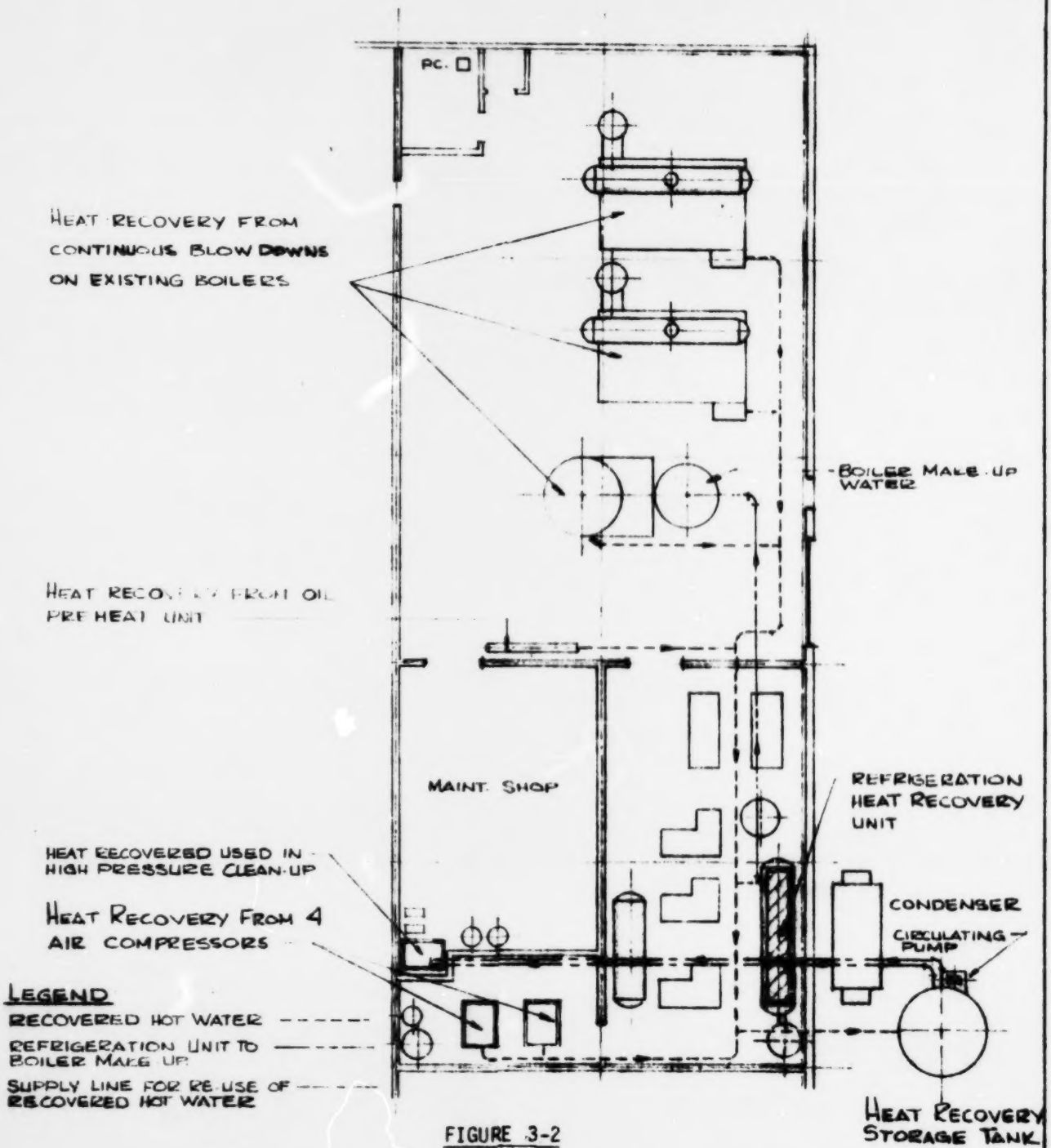

P.C.
HEAT RECOVERY FROM CONTINUOUS BLOW DOWNS ON EXISTING BOILERS
BOILER MAKE-UP WATER
HEAT RECOVERY FROM OIL PRE HEAT UNIT
MAINT. SHOP
REFRIGERATION HEAT RECOVERY UNIT
HEAT RECOVERED USED IN HIGH PRESSURE CLEAN-UP
HEAT RECOVERY FROM 4 AIR COMPRESSORS
CONDENSER
CIRCULATING PUMP
LEGEND
RECOVERED HOT WATER
REFRIGERATION UNIT TO BOILER MAKE UP
SUPPLY LINE FOR RE-USE OF RECOVERED HOT WATER
HEAT RECOVERY STORAGE TANK

FIGURE 3-2

CONNORS BROS., LIMITED: #10 SARDINE CANNERY: BLACKS HARBOUR, N. B.

DISCHARGE WATER: HEAT RECOVERY

IV. ELECTRICAL LOAD MANAGEMENT

1. Introduction

The electrical load management objectives were to reduce monthly peaks of electrical demand through automatic control of electrical equipment. A peak load shed and a power factor correction program is used to achieve this objective. As well, one 40 H.P. air compressor is controlled by the Programmable Controller to run intermittently.

2. Peak Load Shedding

The plant peak demand load shedding is based on two KW transducers, one power factor transducer and the calculated KVA demand. An Allen-Bradley Programmable Logic Controller (PLC) monitors the KVA demand and it automatically sheds loads. Whenever the KVA demand exceeds the high limit the loads are shed in order of importance. All loads shed are stepped on and off with a two minute delay between stages. The shed time for individual equipment is controlled by its individual parameters (temperature, time, pressure, etc.). At times it is difficult to shed some equipment because of their parameters, thus affecting the minimal demand. However, it may be possible to better control those loads through regular cycling.

The KVA peak load shed program was designed to reduce the short duration peak KVA demand which occurs during five months of the year. All plant equipment which is not essential for production is programmed to be shed based on an adjustable KVA set point that was determined from previous years' peak demand. The loads are shed in reverse order of importance.

A total of 226 KW is now being shed from our peak demand. Whenever the KVA demand exceeds the high limit the following loads are shed:

1.	#1, 2 & 3 Blast Freezer Cable Heaters	10 KW
2.	#4 & 5 Blast Freezer Cable Heaters	10 KW
3.	No. 6 Cold Storage Cable Heaters	16 KW
4.	Can Plant Water Heaters	50 KW
5.	Can Plant Ventilation Units (4)	20 KW
6.	Can Plant Air Supply Units (4)	20 KW
7.	No. 6 Cold Storage, No. 1 & 4 Refrigeration Units (no shed above -10 C)	100 KW
	TOTAL	226 KW

In the future Connors Brothers Ltd. will attempt to cycle production loads to further reduce demand. The Allen-Bradley and Apple Computer interface will permit Connors staf to analyze the data being collected from the Programmable Controller and research production during peak periods. This will enable staff to make positive recommendations in cycling production loads.

3. Power Factor

The plant power factor (PF) is controlled by a power factor transducer and a stepped program for the individual capacitors to control the PF at 92% lagging. A total of ten 15 KVAR capacitors are stepped in and out to maintain the required PF.

The power factor correction is used to maintain the power factor at 92% lagging. Under NBEPC power rate structure demands are billed on KVA.

The data collected with the Programmable Controller has shown that the power factor has been leading or lagging at times. Connors is now able to control these capacitors to obtain the proper power factor.

4. Air Compressors

The programmable controller also monitors and controls the No. 3 air compressor for intermittent cycling.

The plant compressed air requires that one 75 h.p. air compressor runs continuously when there is production and that a second compressor (40 h.p.) must run intermittently. Normally, two 75 h.p. compressors were turned on during peak to ensure proper air pressure. An air pressure transducer, 0-200 PSIG, was installed in a 24 VDC series loop with an A-B analog input module. The transducer input value is then programmed to cycle the second compressor as required.

V. MONITORING AND CONTROL SYSTEM

The monitoring and/or control of the energy conservation system in No. 10 Plant is centered around an Allen-Bradley Programmable Logic Controller (PLC 2/30) and its distributed Input/Output (I/O) capabilities.

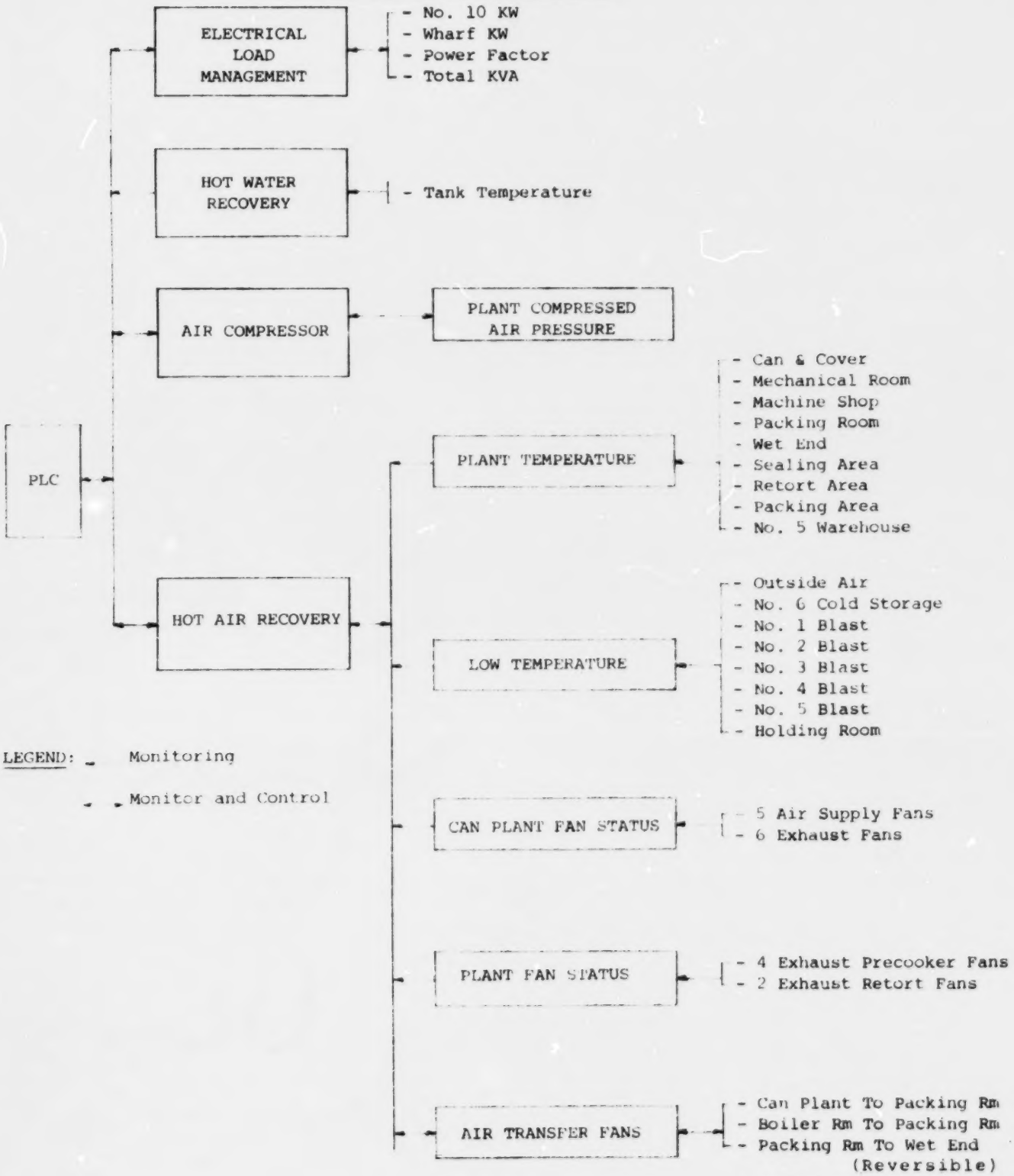
All the areas discussed in this report are now monitored and/or controlled using the programmable controller with the exception of the can washer heat recovery system. For system schematic diagram see figure 5-1.

The programmable controller, in addition to controlling plant air temperatures and electrical load, has the function of collecting relevant data to monitor various energy wastage. Presently there are 55 pieces of information collected hourly by the programmable controller. All of the inputs and output to the PLC are constantly being updated ten times per second. Once per hour these input readings and output status are recorded in the form of a printer message on an EPSON MX-80 printer. See Figure 5-2 for a typical hourly printout. The boiler room operator enters all readings on a daily log sheet which simplifies analysis of the information. See Figure 5-3 for a typical daily log sheet.

For detail of the monitoring system see appendix 1.

FIGURE 5-1

MONITORING & CONTROL SYSTEM



PLANT ELECTRICAL STATUS

225	NO.10 KW.	000780
226	NEARF KW.	029
224	NO.10 POWER FACTOR	.964
	TOTAL KVA DEMAND	000810
222	PLANT AIR	088 PSI
223	RECOVERED WATER TEMP.	018.688 C

PLANT AREA TEMPERATURES - CELSIUS

210	CAN & COVER	028.934
211	MECH. RM.	043.401
212	MACH. SHOP	038.934
220	PACKING RM.	022.287
221	WET END EL.46	020.723
240	SEALING AREA	023.891
241	RETORT AREA	034.242
250	PACKAGING AREA	031.809
251	NO.8 WARE.	026.242

PLANT LOW TEMPERATURE AREAS - CELSIUS
(ON = MINUS)
(OFF = ABOVE 0)

213	OUTSIDE AIR	ON	001.607
226	NO.6 COLD STOR.	ON	026.197
230	NO.1 BLAST	OFF	018.435
231	NO.2 BLAST	OFF	017.282
232	NO.3 BLAST	OFF	017.643
233	NO.4 BLAST	ON	000.000
234	NO.5 BLAST	ON	000.000
235	HOLDING RM.	ON	000.000

CAN PLANT FAN STATUS

11010	M1	AIR SUPPLY	ON
11011	M2	" "	OFF
11012	M3	" "	ON
11013	M4	" "	OFF
11014	M5	" "	OFF
11015	V1	EXHAUST	OFF
11100	V2	" "	OFF
11101	V3	" "	OFF
11102	V4	" "	OFF
11103	V5	" "	OFF
11104	V6	" "	ON

NO.10 PLANT - EXHAUST FAN STATUS

14010	F4	PRECOOKER	OFF
14011	F5	" "	OFF
14012	F6	" "	ON
14013	F7	" "	ON
14014	F16	RETORT	ON
14015	F17	" "	ON

AIR RECOVERY FANS

01212	NO.1	CAN PLANT TO PACKING RM.	ON
02102	NO.2	BOILER RM. TO PACKING RM.	ON
03103	NO.3&4	PACKING RM. TO WET END	OFF
03104	NO.3&4	WET END TO PACKING RM.	OFF
05100	NO.5	PACKAGING RM. TO NO.5 WARE.	ON
03105		NO.3 AIR COMPRESSOR	OFF

FIGURE 5-2

PLC HOURLY PRINTOUT

DATE: Nov. 26-83

#10 PLANT ENERGY PERFORMANCE

TIME:

	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
ELECTRICAL STATUS																								
225 MD. 10 KV	420	410	400	410	390	420	410	430	490	430	410	420	410	400	560	410	440	470	410	400	400	390	410	400
226 WHARF KW	17	17	18	17	18	18	15	15	15	18	20	18	18	20	20	18	18	18	17	17	18	20	20	20
224 POWER FACTOR	.082	.129	.104	.0892	.132	.086	.124	.072	.128	.080	.132	.091	.120	.128	.076	.096	.076	.069	.089	.089	.089	.140	.132	.134	.093
TOTAL KVA	3420	3410	4520	4200	5530	7220	3540	5740	4020	5420	3150	5230	3580	3350	6710	4470	5780	900	4870	4020	4860	3940	4040	3980
222 PLANT AIR	85	85	86	86	86	86	86	85	84	86	86	86	86	86	86	86	87	87	87	85	85	85	86	86
223 RECOVERED WATER T	32.8	32.6	32.8	32.1	32.2	32.2	31.7	31.7	31.2	31.3	31.9	30.9	30.9	30.9	30.2	30.5	30.5	30.5	30.2	30.1	30.1	30.1	29.7	29.7
PLANT TEMP. °C																								
210 CAN & COVER	25.0	24.9	24.1	24.9	24.8	24.8	26.9	26.9	26.9	25.8	26.5	26.9	25.8	27.3	25.4	26.9	25.8	26.5	25.4	23.5	24.1	24.1	24.1	24.2
211 MECHANICAL ROOM	32.8	31.0	30.6	31.0	30.8	30.6	41.0	40.2	40.6	39.8	40.2	40.7	39.8	41.0	39.8	41.0	39.8	40.6	39.6	40.0	40.6	40.2	39.8	39.8
212 MECHANICAL VISP	30.9	30.5	30.5	30.9	30.8	30.5	30.3	30.3	30.7	30.1	30.1	31.0	31.5	32.6	31.6	32.8	32.1	31.4	30.8	30.8	31.0	31.0	31.0	31.0
220 PACKING ROOM	17.9	17.8	17.9	17.9	17.9	17.9	17.9	17.5	17.5	17.9	18.3	18.7	18.7	19.1	19.5	19.1	19.5	19.9	19.6	19.4	19.1	19.1	18.9	18.9
221 WET END	24.5	24.0	24.3	24.5	24.7	24.7	20.3	19.9	19.5	19.9	19.1	19.9	20.3	20.7	21.5	21.8	22.2	19.1	18.3	17.2	17.2	17.7	17.8	17.8
240 SEALING AREA	19.5	18.8	19.1	19.1	19.1	19.4	19.1	18.7	18.7	19.1	19.1	19.5	19.5	19.9	20.3	20.7	20.7	20.7	20.5	20.5	19.9	19.9	19.8	19.8
241 RETORT AREA	20.5	19.8	19.9	19.8	19.8	19.8	19.5	19.5	19.5	19.5	19.5	19.9	20.7	20.3	20.7	20.7	21.1	20.7	20.3	20.3	20.3	19.9	19.9	19.8
250 PACKING AREA	24.2	23.8	23.8	23.8	23.8	23.8	23.4	23.4	23.5	23.0	23.4	23.8	23.8	24.2	24.2	24.6	24.2	24.6	24.2	24.2	23.8	23.5	23.4	23.4
251 MD. 5 WAREHOUSE	26.1	26.5	26.1	26.1	26.1	26.0	25.8	25.6	25.6	25.8	25.8	25.8	26.1	26.1	26.5	26.9	27.9	27.3	27.3	27.3	27.3	27.3	27.3	27.3
LOW TEMPERATURE AREAS																								
213 OUTSIDE AIR	-9.8	-9.0	-9.6	-10.1	-10.4	-9.4	-10.7	-8.2	-9.2	-6.5	-6.1	-5.7	-4.5	-4.9	-1.2	-1.2	-1.6	-1.2	-2.0	-2.3	-4.1	-5.7	-6.3	-6.9
226 MD. 6 COLD STORAGE	-24.3	-24.5	-24.7	-21.5	-21.5	-24.3	-21.7	-21.3	-21.1	-21.3	-21.7	-21.7	-20.1	-20.1	-21.3	-22.5	-21.7	-22.9	-23.5	-23.1	-22.7	-24.2	-24.2	-24.9
230 MD. 1 BLAST	+14.1	+14.1	+14.1	+13.1	+14.1	+14.1	+13.7	+13.7	+13.7	+13.3	+13.3	+13.7	+13.7	+14.1	+14.5	+14.9	+15.2	+14.1	+14.1	+13.7	+13.7	+13.7	+13.7	+13.8
231 MD. 2 BLAST	+13.7	+13.2	+13.7	+13.7	+14.1	+13.5	+13.3	+12.9	+12.9	+12.5	+12.9	+12.9	+12.9	+13.3	+14.1	+14.5	+14.9	+13.3	+13.9	+14.5	+14.5	+14.5	+14.1	+14.1
232 MD. 3 BLAST	+13.5	+13.2	+13.2	+12.5	+13.2	+13.2	+13.3	+12.9	+12.5	+12.5	+12.5	+12.9	+12.9	+13.3	+13.7	+14.1	+14.1	+13.9	+13.9	+13.7	+14.5	+14.5	+14.1	+14.1
233 MD. 4 BLAST	OFFLINE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
234 MD. 5 BLAST	SAME	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
235 HOLDING ROOM	SAME	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CAN PLANT FAN STATUS																								
11010 M1 AIR SUPPLY	ON	ON	ON	OFF	ON	ON	ON	ON	OFF	ON	ON	OFF	ON	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
11011 M2 AIR SUPPLY	OFF	OFF	OFF	"	OFF	OFF	OFF	OFF	"	OFF	OFF	"	OFF	"	OFF	"	OFF	"	OFF	"	"	"	"	"
11012 M3 AIR SUPPLY	ON	ON	ON	"	ON	ON	ON	ON	"	ON	ON	"	ON	"	ON	"	ON	"	ON	"	"	"	"	"
11013 M4 AIR SUPPLY	OFF	OFF	OFF	"	OFF	OFF	OFF	OFF	"	OFF	OFF	"	OFF	"	OFF	"	OFF	"	OFF	"	"	"	"	"
11014 M5 AIR SUPPLY	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
11015 V1 EXHAUST	OFF	OFF	OFF	"	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
11100 V2 EXHAUST	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
11101 V3 EXHAUST	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
11102 V4 EXHAUST	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
11103 V5 EXHAUST	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
11104 V6 EXHAUST	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
EXHAUST FAN STATUS																								
14010 F4 PRECOOKER	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
14011 F5 PRECOOKER	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
14012 F6 PRECOOKER	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
14013 F7 PRECOOKER	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
14014 F16 RETORT	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
14015 F17 RETORT	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
AIR RECOVERY FANS																								
01215 MD. 1 CPPR	OFF	ON	ON	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	OFF	ON	ON	OFF	ON	ON	ON
02102 MD. 2 BRPR	ON	"	"	"	"	"	"	ON	"	"	"	"	"	"	"	"	"	ON	"	"	ON	"	"	"
02103 MD. 3 & 4 PRNE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
02104 MD. 3 & 4 VERP	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
05100 MD. 5 PRSN	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
RECOVERED WATER USAGE	DAY: 2000			EVENING: 1400																				
MAKE-UP WATER	DAY: 2200			EVENING: 2100																				
FUEL USAGE	DAY: 500			EVENING: 440																				

FIGURE 5-3

DAILY LOG SHEET

VI. COMPUTER INTERFACE AND DATA ANALYSIS

1. Problem:

Our existing energy management system includes a Programmable Logic Controller (Allen-Bradley PLC 2/30), which has the ability to monitor and control various energy users in the plant. This computer generates 1,200 pieces of valuable information per 24 hours now, but it does not have the memory or ability to analyze this data, and to employ people to analyse this data in detail is not feasible.

2. Solution:

Purchase a micro computer which can analyze the data from the Programmable Logic Controller (PLC) and present the data in a form which management can act upon.

3. Software:

Because the technology required (software) to interface a PLC with a computer is new, it is expensive. We have engaged Surfline Engineering Ltd. of Dartmouth N.S. to prepare this software to interface an Allen Bradley PLC 2/30 Programmable Logic Controller and an Apple IIe computer.

4. Advantages:

The existing PLC has a small memory and is not designed to analyze in detail. By interfacing this PLC with an Apple IIe microcomputer we will have the ability to store data from the PLC, analyze this data and generate a summary report indicating the problem and energy used. Such a summary report would include:

a) A performance check of #10's new energy monitoring system could be done weekly in a matter of minutes. Areas of energy waste could be pointed out on a weekly basis.

b) A report on energy performance per area at #10 could be generated. This would allow credit to be given to departments that improve on their energy performance and also point out problem areas.

c) Cumulative data could be collected and stored in the computer to show savings in implemented energy conservation projects, i.e. (a) ceiling fans; (b) thermostats; (c) insulation; (d) reduced exhaust air; (e) peak power shedding, etc.

Some more specific advantages are include in table 6-1.

5. Cost Estimate:

Apple IIe Computer with 128 K plus accessories.	$ 5,521
Software Interface (Surfline).	5,500
Programming for report generation.	4,600
Engineering and installing.	3,800
TOTAL COST	$ 19,420

6. Demonstration:

Allen-Bradley PLC systems represent approximately 75% of all programmable controllers installed in industries in Atlantic Canada. To interface this system with a microcomputer would demonstrate the technology for the first time. We expect this will generate much interest in future uses of computers for better energy management.

7. ADDENDUM AT TIME OF PRINTING:

The Apple IIe computer and interface to the Allen-Bradley PLC is now completed as projected above.

TABLE 6-1

SPECIFIC ADVANTAGES

A. Exhaust Fans:

PROBLEM: One 12,000 cfm fan ran for 12 hours unnecessarily and cost us $ 6.17 per hour or $ 74 for 12 hours in lost heat.

SOLUTION: With the PLC and a microcomputer this could be monitered and avoided.

B. Steam Unit Heaters:

RECOMMENDATIONS:

1. It is our intention to evenually time each heater, when it is running and calculate Btu's used to heat each individual area. This will be done by the number and size of each heater and compared to the total number of heaters and total fuel usage during a heating period. With a computer we can then prove or disprove changes recommended for energy conservation. Also, a daily check to evaluate these changes can be done.

2. We would plot graphs of temperature per department per day using accumulated data received from PLC. These curves would be compared with ideal curves established under similar circumstances stored in memory. This would help us prove energy saved by implementing proposals.

C. Peak Power Shedding:

At present we are receiving, on the hour, our KVA demand from PLC. We are shedding a maximum of 226 KVA automatically. With accumulated data we hope to determine a pattern of peak demands on a daily basis and, if possible, change some process to off-peak hours. This can be done much easier by computer and should save many energy dollars.

For example, if system to shed peak power failed resulting in addtion 226 KVA peak set, this would cost us $ 1,515/month ($7.45/Kw x 226 Kw x 90%).

In addition, by recording our peaks we will have a check on monthly peak demands which we are charged for. Also, power factor correction can be monitored, which will save us money.

VII. SYSTEM PERFORMANCE AND SAVINGS

1. Introduction

Monitoring the performance of the system began on October 1/83. Estimated system performance and savings to date, based on a combination of observed measurements and theoretical calculations, are as follows. Detailed calculations of savings for each area are included in Appendix 2.

2. Hot Air Recovery

Approximately 60% of the volume of previously exhausted hot air is being recovered. This hot air directly replaces cold make-up air supply and it reduces heating requirements. The system recovers 12,000 cfm of the 20,000 cfm of 27 C air previously being exhausted. The energy recovered represents savings of approximately $29,052 per year.

3. Hot Water Recovery (See Table 7-1)

Approximately 69% of the energy being recovered from waste water is being used. 26.1 million Btu's per day are recovered through waste water, of which 18.1 million per day is used in various operations.

3.7 million Btu's/day from the 5,000 gallons storage tank are used in the clean-up system water during the refrigeration season. In the non-freezing season 4.5 million Btu's/day are used. Savings are as follows:

A. Available Hot Water

SOURCES	SAVINGS	GALS/DAY	DETAIL
a) Refrigeration (Excess)	6,053	18,000	Appendix 2-4
b) Air Compressor	5,231	5,600	Appendix 2-5
c) Boiler Oil Preheater	2,055	1,100	Appendix 2-6
d) Continuous Blowdown	1,143	408	Appendix 2-7
e) TOTAL	$ 14,482	25,108	

B. Use In Hi-Pressure Clean-Up

a) Refrigeration Season	$ 3,110	8,000	Appendix 2-9
b) Non-Refrigeration Season	4,630	7,108	Appendix 2-8
c) TOTAL	$ 7,740		

C. Excess Available

a) Refrigeration Season	$ 6,742	17,108	Appendix 2-9

D. Summary: For detail see Table 7-1

There are potential savings of $14,482 by using all of the hot water recovered. We are presently recovering 25,000 gals/day from the available sources during the refrigeration (freezing) season. However, we can only use 8,000 gals/day of this in the high pressure cleaning system for a savings of $7,740/year. There are potential additional annual savings of $6,742/year should we find an application for approximately 17,000 gals of 96 F water, which are available during the 90 days peak freezing period.

All of the 4.8 million Btu's/day recovered from the heat exchanger installed on the refrigeration system are reused to preheat the boiler make-up water. Annual savings are estimated at $4,035/year.

All of the 9.6 million Btu's per day recovered from the can washers by using a heat exchanger are reused to preheat the can washers make-up water supply at a flow rate of 20 gpm. Annual savings are estimated at $17,934/year.

4. Electrical Load Management

The programmable controller has been programmed to successfully control the plant power factor at 92% lagging. Estimated savings of $5,453 per year.

The KVA peak load shed program was designed to reduce the short durations peak KVA demand which occurs during five months of the year. All plant equipment which is not essential for production is programmed to be shed based on an adjustable KVA set point that was determined from previous years' peak demand. The loads are shed in reverse order of importance. The loads shed total 226 KW, all of which have a temperature override switch. Our existing demand is approximately 1500 KVA. Annual savings, which are dependent on production, is estimated at $13,470.

The plant compressed air pressure is monitored by the PLC and one compressor is cut in or out automatically to use minimum h.p. In the past staff manually started and used two 75 h.p. compressors during peak periods. These peaks were sporadic but large compessors were left on in case demand was required. We expect this system to save Connors Bros. an estimated $1,788/year, depending on production needs.

TABLE 7-1

HEAT FROM WASTE HOT WATER

HEAT RECOVERY						HEAT USED					
		HOURLY		DAILY				HOURLY		DAILY	
SOURCES	TEMP. °F	GALS.	Btu's x 10^6	GALS.	Btu's x 10^6	APPLICATIONS	TEMP. °F	GALS.	Btu's x 10^6	GALS.	Btu's x 10^6
1. Refrigeration	90*	600	.24	12,000**	4.8	1. Boiler Make-Up	90.0*	600	.24	12,000**	4.8
2. a) Refrigeration	90*	900	.36	18,000	7.2	2. High Pressure Clean Up (Refrig Season)	96.6	400	.1864	8,000**	3.728
b) Air Compressors	100*	350	.210	5,600***	2.8						
c) Oil Preheaters	150*	55	.055	1,100**	1.100						
d) Blowdown	200*	51	.765	408****	.612	Non-Refrig. Season	113.4	355.4	.225	7,108**	4.5
TOTAL	96.6*	1,356	1.39	25,108	11.712						
3. Can Washers	130*	1,200	.960	12,000	9.600	3. Can Washers	130	1,200	.960	12,000	9.6
4. TOTAL		3,156	2.59	49,108	26.112	(Refrig Season)		2,200	1.3864	32,000	18.128
						69% of the heat recovered is being used.					

NOTES:
* Make-up water @ 50°F (heat gained and heat used calculated using 50°F make-up water).
** 20 hours per day.
*** 16 hours per day.
**** 8 hours per day.

5. Summary:

	AREA	SAVINGS
1.	Hot Air Recovery	$ 29,052
2.	Hot Water Recovery - Can Washers	17,934
3.	Hot Water Recovery - Refrigeration	4,035
4.	Hot Water Recovery - Tank	7,740
5.	Electrical Load Management:	
	a) Power Factor	$ 5,453
	b) Peak Load Shedding	13,470
	c) Air Compressor Cycling	1,788
	d) SUB-TOTAL	$ 20,711
6.	TOTAL	$ 79,472

IX. CAPITAL COST

1. SUMMARY:

	ITEMS	LABOUR	EQUIPMENT	TOTAL ACTUAL	TOTAL BUDGET
1.	Hot Water Recovery				
	a) - Tank	$ 12,795	$ 4,205	$ 17,000	$ 20,000
	b) - Refrigeration	2,365	12,635	15,000	21,000
	c) - Can Washers	2,272	5,728	8,000	6,000
	SUB-TOTAL	$ 17,432	$ 22,568	$ 40,000	$ 47,000
2.	Hot Air Recovery	$ 3,769	$ 14,231	$ 18,000	$ 12,000
3.	Monitor & Control	13,411	26,589	40,000	30,000
4.	Programmable Controller	5,872	44,123	50,000	45,000
5.	Design & Engineering	11,000	-	11,000	13,000
6.	Reports & Demonstration	23,000	-	23,000	35,000
7.	Computer Interface	6,803	13,197	20,000	20,000
8.	TOTAL	$ 81,287	$ 120,713	$ 202,000	$ 202,000

2. DETAIL:

1. Equipment List: See Appendix 3-1.

2. Installation - Detail: See Appendix 3-2.

3. Brochures on major equipment: See Appendicies 3-3 to 3-8.

4. Note: Connors Bros. Ltd. designed and installed total system.

X. INFORMATION TRANSFER

From May/82 to March/84 numerous information transfer activities served to inform the general public and those with direct interest about the project. In addition to distribution of the Project Summary, seven radio interviews were aired, two newspaper articles appeared, numerous tours were held, and a seminar on Energy Conservation in the Fishing Industry was offered in Moncton.

X. CONCLUSIONS

1. The project was economically successful. Savings of $ 79,472 were achieved with a Capital Cost of $ 202,000 giving a payback of 2.5 years. In addition, this capital cost was higher than required as this was a demonstration project.

2. The technology was successfully demonstrated.

3. The technolgies demonstrated may be applied in parts or in whole to a great variety of industries.

4. Monitoring of the project continues. Further measurement of the system's performance are required to more accurately assess the savings achieved.

5. Software interface between Apple and Allen Bradley PLC is now complete. This will enable more accurate assessment of system performance.

6. Payback is unpredictable because of the uncertainty of annual fish landings. The quantity of fish, the size of the fish and the quality will determine the production process and energy consumed.

7. The demonstration project has been a learning tool for Connors Bros., Limited's personnel. It has helped staff become qualified in a field of technology that is growing rapidly.

XII. RECOMMENDATIONS

1. General:

   Any of these technologies demonstrated may be implemented individually or in groups. They also apply to industries other than the fishing industry.

2. Connors:

   1. Monitoring of the project. More complete measurements of system's perfomance is required to more accurately assess the savings achieved.

   2. Hot water recovery tank. Do more work in balancing available excess hot water and other potential uses (Btu balance). Other potential users could include rack washers, pan washers, domestic hot water. Other future sources could include retort cooling water, precooker waste water (use a heat exchanger).

   3. Use interface between Apple IIe and Allen Bradley PLC to reduce other energy costs in the plant, eg. through lighting control, cycling of electrical loads to decrease peak demand etc.

APPENDIX 1

MONITORING SYSTEM - DETAIL

1. PLC

The PLC 2/30 has an 8 K memory and an 896 I/O capacity which is sufficient to handle forseeable energy conservation and control functions. The I/O capabilities are divided into a maximum of seven (7) 128 I/O racks that are remotely located from the central processor unit (CPU) at various motor control centers throughout the plant. Communication from the remote I/O racks and the CPU is via a single shielded 2-wire cable that has a maximum distance limitation of 10,000 feet.

The PLC 2/30 has numerous types and voltages of I/O modules available. The modules used with this system are:

a) Analog Input: 8 bit, 4-20 MA.
b) Isolated 120 V input.
c) Isolated 120 V output.
d) 24 VDC input.

2. Monitoring Outline

See Figure A1-1 attached (corresponds to Figure 5-1). Figures A1-2 to A1-5 are examples of measurments made in analyzing the system's results.

3. Hot Air Recovery

The temperature monitoring is based upon a 4.20 MA signal from a remotely mounted RTD (Resistance Thermometer) and a two-wire temperature transmitter in a 24 VDC series loop within an Allen-Bradley (A-B) analog input module. The areas monitored by RTD's are:

a) 6 Main Plant Areas
b) 1 Outdoor Air Temperature
c) 5 Blast Freezers and 1 Cold Storage
d) 1 Recovered Hot Water Tank

The plant air temperature control is based on temperature inputs from RTD's in the areas involved and the outdoor air temperature. A program was entered in the PLC 2/30 that compares an area temperature to a pre-determined adjustable set point and the outdoor air temperature. If heating or cooling is required, five air make-up or six exhaust fans are energized to control the temperature within 2 C of the set point. There is also provisions for a temperature set-back of 10 C when the plant is not operating which is based on a 7-day time clock and monitoring a major piece of plant equipment for operation.

The plant air pressure monitoring is based on a 4.20 MA signal from a pressure transducer in a 24 VDC series loop with A-B analog input module which converts the signal to a B/D value that is mathematically converted to represent the instantaneous air pressure.

APPENDIX 1

MONITORING SYSTEM - DETAIL

3. Hot Air Recovery cont'd

The operation of the five 10,000 CFM hot air recovery fans is controlled by RTD temperature inputs from both the warm supply areas and the cool receiving areas. If the temperature is above 24 C in the warm area and below 22 C in the cool area, the appropriate recovery fan will run.

Two of the recovery fans are dual purpose in that they are reversible for summer cooling. Reverse flow for cooling is controlled by the outdoor air temperature RTD and the process area temperature RTD.

The four 12,000 CFM precookers and the two 12,000 CFM retort exhaust fans are monitored for operation. A status report is printed every hour to ensure that the fans are not left running during non-operating hours.

4. Electrical Load Management

The plant energy usage monitoring is based on a 4-20 MA signal from two (2) kilowatt transducers and one(1) power factor transducer, in a 24 VDC series loop with and A-B analog input module. This converts the input signal to a BcD value that is mathematically converted to represent the instantaneous KW demand, power factor and KVA readings.

The plant power factor (PF) is controlled by a power factor transducer and a stepped program for the individual capacitors to control the PF at 92% lagging. A total of ten (10) 15 KVAR capacitors are stepped in and out to maintain the required PF.

The plant Peak Demand Load shedding is based on two KW transducers, one power factor transducer and the calculated KVA demand. When the KVA demand exceeds the high limit then loads are shed in order of importance. All loads shed are stepped on and off with a two (2) minute delay between stages.

5. Compressed Air

The plant compressed air requires that one (1) 75 h.p. air compressor run continuously when there is production and that a second compressor (40 h.p.) must run intermittently. An air pressure transducer, 0-200 PSIG, was installed in a 24 VDC series loop with an A-B analog input module. The transducer input value is then programmed to cycle the second compressor as required.

6. Hot Water Recovery

With this system only the tank temperature is monitored to determine the system's effectiveness. No part of this system is controlled by the PLC.

FIGURE A1-1

MONITORING OUTLINE

1. TEMPERATURE MONITORING

   a) 9 RTDS (Resistance Temperature Device) for various plant areas temperature.
   b) 1 RTD for outdoor temperature.
   c) 6 RTDS for blast freezers 1 to 5 and No. 6 Cold Storage temperature.
   d) 1 RTD for recovered hot water temperature.

2. PLANT ELECTRICAL MONITORING

   a) 1 Wharf KW transducer.
   b) 1 No. 10 KW transducer.
   c) 1 No. 10 power factor transducer.

3. PLANT AIR PRESSURE MONITORING

   a) 1 Air pressure transducer.

4. PLANT AIR USAGE AND TEMPERATURE CONTROL

   a) Control (5) air supply units in Can Plant by temperature.
   b) Control (6) air exhaust units in Can Plant by temperature.
   c) Monitor (6) exhaust fans in No. 10 precook and retort areas.

5. HOT AIR RECOVERY

   a) Control air flow from Can Plant to Packing Room by temperature.
   b) Control air flow from Boiler Room to Packing Room by temperature.
   c) Control air flow from Packing Room to Wet End by temperature.
   d) Control air flow from Wet End to Packing Room by temperature (cool).
   e) Control air flow from packaging area to No. 5 Warehouse by temperature.

6. PLANT COMPRESSED AIR

   a) No. 3 air compressor cycles on or off as required to maintain air pressure.

7. POWER FACTOR CORRECTION

   a) No. 10 Plant P.F. is controlled by stepping in or out 10 capacitors, depending on PF transducer. Regulates P.F. at 90 to 95%. (More capacitors may be necessary as plant goes into full production.)

8. PEAK LOAD SHEDDING

   a) Control peak electrical demand by shedding loads based on KVA demand total for plant.
   b) Loads shed:

1.	No. 1, 2 & 3 Blast Freezer Cable Heaters	10 KW
2.	No. 4 & 5 Blast Freezer Cable Heaters	10 KW
3.	No. 6 Cold Storage cable heaters.	16 KW
4.	Can Plant water heaters.	50 KW
5.	Can Plant ventilation units (4).	20 KW
6.	Can Plant air supply units (4).	20 KW
7.	No. 6 Cold Storage No. 1 & 4 refrigeration units (no shed above -10°F).	100 KW
	TOTAL	226 KW

FIGURE A1-2

COMPUTER REPORT

ELECTRICAL STATUS 225

Ave KW 6pm to 6 am ave kw from 6 am to 6 pm
Peak Demand = PD KVA
Plant #10

DATE	AVE DAY	AVE NIGHT	PEAK	TIME	LOW	TIME
March 21	917	650	1100	1500	420	0500
" 20	476	480	690	1300	405	1900
" 19	585	587	800	0100	480	1300
" 18	993	734	1110	1200	490	0300
" 16	982	664	1110	1500	430	0500
" 15	947	647	1090	1000	410	0300
" 14	935	610	1070	1500	420	0300
" 13	478	463	570	1000	410	0500
" 12	464	460	540	2200	400	2100
" 11	752	505	880	1100	420	0500
" 10	910	653	1030	1000	470	0300
" 9	860	565	1080	1600	420	0300
" 8	950	612	1070	1000	440	0400
" 7	950	612	1110	1500	470	0400

REMARKS:

FIGURE A1-3

PLANT ENERGY PERFORMANCE

RECOVERED WATER USAGE

Gal. Used Day
-- Gal. Used Night
223 Recovered Water Temp.

DATE	GAL/DAY	AVE. TEMP	GAL/NIGHT	AVE. TEMP.
March 21	-	+6	4930	+4
" 20	-	+6.5	-	+5.5
" 19	-	+4	-	+4
" 18	1090	+3	3440	+2
" 16	250	+3	2500	+2
" 15	390	+5	4930	+2
" 14	50	+3.5	5010	+2.7
" 13	-	+3	-	+3
" 12	-	+3	-	+2.5
" 11	110	+3	-	+3
" 10	580	+3	4310	+2
" 9	120	+1	5360	+1
" 8	890	-4	4510	-6
" 7	2700	-1	5590	-1

REMARKS:

FIGURE A1-4

#10 PLANT ENERGY PERFORMANCE

BOILER MAKEUP WATER

GAL. USED/DAY
GAL. USED/NIGHT

DATE	GAL/DAY	GAL/NIGHT
March 21	8300	2000
20	1300	1000
19	1400	1300
18	6000	1500
16	9900	2000
15	9100	1700
14	8100	1700
13	900	1300
12	1500	1200
11	1700	1300
10	10700	3000
9	7200	1500
8	8900	260
7	4700	3300

REMARKS:

FIGURE A1-5

10 PLANT ENERGY PERFORMANCE

FUEL USAGE

Gal/Day
Gal/Night

DATE	GAL/DAY	GAL/NIGHT
March 21	1210	90
20	90	250
19	170	210
18	760	140
16	1080	200
15	1110	220
14	1020	300
13	100	250
12	110	90
11	300	190
10	930	180
9	870	200
8	1070	1700
7	1070	500

REMARKS:

APPENDIX 2

SAVINGS CALCULATIONS - DETAIL

APPENDIX 2-1 Hot Air Recovery
APPENDIX 2-2 Hot Water Recovery - Can Washer
APPENDIX 2-3 Hot Water Recovery - Refrigeration
APPENDIX 2-4 Hot Waste Water Recovery Tank - Refrigeration System
APPENDIX 2-5 Hot Waste Water Recovery Tank - Air Compressors
APPENDIX 2-6 Hot Waste Water Recovery Tank - Boiler Oil Preheaters
APPENDIX 2-7 Hot Waste Water Recovery Tank - Continuous Blowdown
APPENDIX 2-8 Hot Waste Water Recovery Tank - High Pressure Clean-Up System
APPENDIX 2-9 Hot Waste Water Recovery Tank - Extra Water
APPENDIX 2-10 Power Factor
APPENDIX 2-11 Peak Load Shedding
APPENDIX 2-12 75 H.P. Air Compressors

APPENDIX 2-1

HOT AIR RECOVERY - COST SAVINGS CALCULATIONS

Savings are based on the cost of heating the make-up air (12,000 cfm*) from 30 F to 80 F for 24 hours. The energy recovered is based on the following equation:

(1) HEAT = M C T

Where M = Mass of air (lbs)
C = Specific Heat of air (Btu's/ F/Lb)
= 0.24 Btu's/ F/Lb.
T = Temperature Difference (F) = 80 F - 30 F = 50 F

The mass of air (M) is based on the following equation:

(2) M = Volume x Density x Time
M = (12,000 cu.ft./min.) x (.075 lbs/cu.ft.)
x (60 mins/hour x 24 hrs/day)
M = 1,296,000 lbs/day

Substituting equation (2) into (1):

(3) HEAT = (1,296,000 lbs/day)x(0.24 Btu's/ F/lb)x(50 F)
= 15,552,000 Btu's/Day

The cost to produce this energy using #6 oil at $ 1.02/gallon with a 60% efficient system is as follows:

$$(4)\quad \text{COST} = \frac{(\text{Energy/Heating Value of Oil})^{*} \times \text{Fuel Cost}}{\text{System Efficiency}}$$

The heating value of #6 Oil = 182,000 Btu's/gallon.

Therefore:

$$(5)\quad \text{COST} = \frac{(15{,}552{,}000\ \text{Btu's/Day})/(182{,}000\ \text{Btu's/Gal}) \times \$\ 1.02/\text{Gal.}}{0.6}$$

COST = $ 145.26/Day

ANNUAL SAVINGS

The annual savings are based on an operating year of 200 days. (Hot air recovery used to heat plant.)

Annual Savings = $ 145.26/Day x 200 Days/Year
= $ 29,052

NOTE: * This hot air is provided by two (2) 10,000 cfm transfer fans: one (1) 10,000 cfm fan from the Boiler Room to the packing area runs continuously; the one (1) 10,000 cfm fan from the Can Plant to the packing area runs intermittently. We are assuming it delivers approximately 2,000 cfm per 24 hours to the packing area.

APPENDIX 2-2

HOT WATER RECOVERY - CAN WASHER

COST SAVING CALCULATIONS

Savings are based on the cost of heating make-up water (20 gals/min.) from 50 F to 130 F at 10 hours per day.

The energy equation: HEAT = M C T

Where M = Mass = (Volume/Min) x (Time) x (Density)

M = 20 gals/min x 60 mins/hr x 10 hrs/day x 10 lbs/gal.

= 120,000 Lbs/Day

HEAT = 120,000 Lbs x 1 Btu/Lb/ F x (130 F - 50 F)

= 9,600,000 Btu's/Day

COST:

Cost of Producing this energy using #6 oil at $ 1.02/Gal. with a 60% efficient heating system for 200 days:

$$\text{ANNUAL SAVINGS} = \frac{9{,}600{,}000 \text{ Btu's/Day}}{\frac{182{,}000 \text{ Btu's/Gal}}{0.6}} \times \frac{\$1.02}{\text{Gal}} \times \frac{200 \text{ Days}}{\text{Year}}$$

= $ 17,934/Year

NOTES - Btu's/Year = 9.6 M/Day x 200 Days/Year = 1,920 M Btu's/Year.

APPENDIX 2-3

HEAT RECOVERY FROM REFRIGERATION HEAT EXCHANGER

When estimating energy savings from heat exchangers on hot gas line of refrigeration system, we must be aware that the total heat available depends on the refrigeration load, which varies continually according to production.

We use approximately .166 gal of fuel for every gal of boiler make-up water used. When we are freezing and heat is recovered from hot gas line, the temperature of our boiler make-up water rises approximately 40 F, from 50 F to 90 F (10 C-32 C).

On an average day we would use approximately 12,000 gals of boiler make-up water. We estimate approximately 90 days of freezing/year.

ESTIMATED SAVINGS

HEAT = M C T

Mass = Volume x Density

$$= \frac{12{,}000 \text{ gals}}{\text{Day}} \times \frac{10 \text{ lbs}}{\text{gal.}}$$

= 120,000 Lbs/Day

$$\text{Heat} = \frac{120{,}000 \text{ lbs}}{\text{Day}} \times \frac{1 \text{ Btu}}{\text{F/Lb}} \times (90 \text{ F} - 50 \text{ F})$$

= 4,800,000 Btu's/Day

$$\text{Cost} = \frac{\frac{4{,}800{,}000 \text{ Btu's/Day}}{182{,}000 \text{ Btu's/Gal}}}{0.6} \times \$ 1.02/\text{Gal} \times 90 \text{ Days}$$

= $ 4,035

Btu's/Year = 432 mm Btu's/Year

APPENDIX 2-4

5,000 GALLONS STORAGE TANK

POTENTIAL SAVINGS - REFRIGERATION SYSTEM

The heat exchangers installed in hot gas line of refrigeration system heats approximately 30,000 gals daily of 50 F water to 90 F.

12,000 gals of this water is used direclty for boiler make-up water. The remaining 18,000 gals are channelled to the 5,000 gals storage tank.

Heat Gained = MC^T

Where M = 18,000 gals x 10 lbs/gal = 180,000 lbs.
C = 1 Btu/lb/ F
^T = 90 F - 50 F = 40 F

Therefore, Heat = 180,000 Lbs x 1 Btu/lb/ F x 40 F
= 7.2 million Btu's

POTENTIAL SAVINGS

$$\text{Annual Savings} = \frac{\text{Heat/Btu's/Gal}}{\text{Heating System Efficiency}} \times \text{Cost/Gal} \times \text{Days}$$

Where: Heat = 7.2 million Btu's
Btu's/Gal = 182,000 Btu's/Gal #6 Oil
Heating System Efficiency = 60%
Cost/Gal = $ 1.02/Gal. #6 Oil
Days = Days in which freezing operation is at peak (90 days).

$$\text{Therefore Annual Savings} = \frac{\frac{7,200,000}{182,000} \times 1.02 \times 90}{0.6}$$

= $ 6,053/Year

APPENDIX 2-5

5,000 GALLONS STORAGE TANK

POTENTIAL SAVINGS - AIR COMPRESSORS

Our air compressors are cooled with fresh 50 F water. Approximately 5,600 gals daily are heated to 100 F. This hot water is channelled to the 5,000 gals storage tank.

Heat Gained = MCΔT

Where M = 5,600 gals x 10 lbs/gal = 56,000 lbs.
C = 1 Btu/lb/ F
ΔT = 100 F - 50 F = 50 F

Therefore, Heat = 56,000 Lbs x 1 Btu/lb/ F x 50 F
= 2.8 million Btu's

POTENTIAL SAVINGS

$$\text{Annual Savings} = \frac{\text{Heat/Btu's/Gal}}{\text{Heating System Efficiency}} \times \text{Cost/Gal} \times \text{Days}$$

Where: Heat = 2.8 million Btu's
Btu's/Gal = 182,000 Btu's/Gal #6 Oil
Heating System Efficiency = 60%
Cost/Gal = $ 1.02/Gal. #6 Oil
Days = Days in which air compressor operation is at peak (200 days).

$$\text{Therefore Annual Savings} = \frac{\frac{2,800,000}{182,000}}{0.6} \times 1.02 \times 200$$

= $ 5,231/Year

APPENDIX 2-6

5,000 GALLONS STORAGE TANK

POTENTIAL SAVINGS - BOILER OIL PREHEATER

The oil used in our boiler is preheated with 400 F steam. As the oil is heated the steam is condensed to water. This hot water is channelled to the hot water storage tank. The oil preheaters deliver approximately 1,100 gals of 150 F water daily.

Heat Gained = MCΔT

Where M = 1,100 gals x 10 lbs/gal = 56,000 lbs.
C = 1 Btu/lb/ F
ΔT = 150 F - 50 F = 100 F (This water directly replaces make-up water at 50 F.)

Therefore, Heat = 11,000 Lbs x 1 Btu/lb/ F x 100 F
= 1.1 million Btu's

POTENTIAL SAVINGS

$$\text{Annual Savings} = \frac{\text{Heat/Btu's/Gal}}{\text{Heating System Efficiency}} \times \text{Cost/Gal} \times \text{Days}$$

Where: Heat = 1.1 million Btu's
Btu's/Gal = 182,000 Btu's/Gal #6 Oil
Heating System Efficiency = 60%
Cost/Gal = $ 1.02/Gal. #6 Oil
Days = Days in which boiler operation is at peak (200 days).

$$\text{Therefore Annual Savings} = \frac{\frac{1,100,000}{182,000} \times 1.02 \times 200}{0.6}$$

= $ 2,055/Year

APPENDIX 2-7

5,000 GALLONS STORAGE TANK

POTENTIAL SAVINGS - CONTINUOUS BLOWDOWN

The boiler continuous blowdown supplies steam and water at 400 F. However, this steam is condensed to water to prevent buildup of pressure in the delivery piping to the storage tank. The water is measured to be 200 F by the time it is delivered to the main recovery line. Approximately 408 gallons recovered daily.

Heat Gained = MC T

Where M = 408 gals x 10 lbs/gal = 4,080 lbs.
C = 1 Btu/lb/ F
T = 200 F - 50 F = 150 F (This water directly replaces make-up water at 50 F.)

Therefore, Heat = 4,080 Lbs x 1 Btu/lb/ F x 150 F
= 612,000 Btu's/Day

POTENTIAL SAVINGS

$$\text{Annual Savings} = \frac{\text{Heat/Btu's/Gal}}{\text{Heating System Efficiency}} \times \text{Cost/Gal} \times \text{Days}$$

Where: Heat = 612,000 Btu's
Btu's/Gal = 182,000 Btu's/Gal #6 Oil
Heating System Efficiency = 60%
Cost/Gal = $ 1.02/Gal. #6 Oil
Days = Days in which boiler operation is at peak (200 days).

$$\text{Therefore Annual Savings} = \frac{\frac{612{,}000}{182{,}000} \times 1.02 \times 200}{0.6}$$

= $ 1,143/Year

APPENDIX 2-8

5,000 GALLONS STORAGE TANK

ACTUAL SAVINGS - HIGH PRESSURE CLEAN-UP SYSTEM

Presently we are recovering 25,108 gals daily from various operations. However, the high pressure clean-up system uses approximately 8,000 gals. at 96.6 F from the hot water storage tank as long as refrigeration is at peak (90 day period). For the remaining of the peak season (110 days), when there is no heavy refrigeration on, there is only 7,108 gals available from the storage tank for the high pressure clean-up system. The additional 17,108 gals of 96.6 F water is available for further applications for 90 days of the year. See Appendix 2-9 for potential savings. NOTE: This water must still be heated by other means from 96.6 F (36 C) to 52 C for use in the high pessure system.

Heat Gained = MC T

Where M = 1. With Refrigeration:
m = 8,000 gals x 10 lbs/gal = 80,000 lbs.
2. Without Refrigeration:
m = 7,108 gals x 10 lbs/gal = 71,080 lbs.
C = 1 Btu/lb/ F
'T = 96.6 F - 50 F = 46.6 F for Refrigeration Season
= 113.4 F - 50 F = 63.4 F for Non-Refrigeration Season

Therefore, Heat = 1. With Refrigeration:
80,000 Lbs x 1 Btu/lb/ F x 46.6 F
= 3.7 Million Btu's/Day

2. Without Refrigeration:
71,080 Lbs x 1 Btu/lb/ F x 63.4 F
= 4.5 Million Btu's/Day

POTENTIAL SAVINGS

$$\text{Annual Savings} = \frac{\text{Heat/Btu's/Gal}}{\text{Heating System Efficiency}} \times \text{Cost/Gal} \times \text{Days}$$

Therefore Annual Savings:

1. With Refrigeration: $\dfrac{\dfrac{3,700,000}{182,000} \times 1.02 \times 90}{0.6}$

= $ 3,110/Year

2. Without Refrigeration: $\dfrac{\dfrac{4,500,000}{182,000} \times 1.02 \times 110}{0.6}$

= $ 4,630/Year

TOTAL ANNUAL SAVINGS = (1) + (2)

= $ 3,110 + $ 4,630 = $ 7,740/YEAR

APPENDIX 2-9

5,000 GALLONS STORAGE TANK

POTENTIAL SAVINGS - EXTRA WATER DURING REFRIGERATION PEAK PERIOD

During the period of peak freezing there is an additional 17,000 gals of 96.6 F water which is recovered but not used. Should an application for this water be made available it would represent a potential savings of $ 6,742/year.

Heat Gained = MCΔT

Where M = 17,108 gals x 10 lbs/gal = 171,080 lbs.
C = 1 Btu/lb/ F
ΔT = 96.6 F - 50 F = 46.6 F

Therefore, Heat = 171,080 Lbs x 1 Btu/lb/ F x 46.6 F
= 7.9 Million Btu's

POTENTIAL SAVINGS

$$\text{Annual Savings} = \frac{\text{Heat/Btu's/Gal}}{\text{Heating System Efficiency}} \times \text{Cost/Gal} \times \text{Days}$$

Where: Heat = 7.9 Million Btu's
Btu's/Gal = 182,000 Btu's/Gal #6 Oil
Heating System Efficiency = 60%
Cost/Gal = $ 1.02/Gal. #6 Oil
Days = Days in which freezing operation is at peak (90 days).

$$\text{Therefore Annual Savings} = \frac{\frac{7,900,000}{182,000} \times 1.02 \times 90}{0.6}$$

= $ 6,742/Year

APPENDIX 2-10

POWER FACTOR

COST SAVINGS CALCULATIONS

YEAR	MONTH	KW	P.F. (%)	KVA (KW/P.F.)	
1982	Oct.	1,536	84.2	1,824	
	Nov.	1,344	84.9	1,584	
	Dec.	1,368	89.7	1,524	
1983	Jan.	1,392	85.3	1,632	
	Feb.	1,392	86.6	1,608	
	March	1,392	88.9	1,584	
	April	816	90.7	900	
	May	900	91.5	984	
	June	1,176	91.6	1,284	
	July	1,512	83.4	1,812	
	Aug.	1,512	83.8	1,778	
	Sept.	1,488	83.8	1,776	
	Oct.	1,512	90.0	1,680	PC On Line
	Nov.	1,440	91.0	1,572	
	Dec.	1,248	92.9	1,344	

	Average Oct. '82-Sept. '83	Average Oct. '83-Dec. '83	Savings
KW	1,383	1,383	-
P.F.	86.2	91.2 (90%)	-
KVA (KW/P.F.)	1,604	1,537	67 KW/Month
BILLED KVA (90%)	1,443.6	1,383	60.6 KW/Month

SAVINGS: 61 KW/Month x 12 Months x $ 7.45/KW = $ 5,453/Year

APPENDIX 2-11

PEAK LOAD SHEDDING

COST SAVINGS CALCULATIONS

From Chapter 4 we see that we can shed 226 KW when required.

According to NBEPC rate structure (Heavy Industrial), if we save 226 KW during January, February and March, then the savings will be reflected through the rest of the year. However, since August to November are months that we exceed January's billing, because of production demand, it is not always possible to shed the full 226 KW. Therefore, for these months we only forecast a savings of 50% of the 226 KW. The other months we assume a 75% savings of the 226 KW, although in January, 1984 we have maintained the demand at the set point limits.

SAVINGS:

DEMAND: Assuming a power factor of 90% = KVA = 1 KW:

4 Months (Aug.-Nov.) = 226 KW/Month x 50% x 4 Months = 452 KW
8 Months (Dec.-July) = 226 KW/Month x 75% x 8 Months = 1,356 KW

TOTAL = 1,808 KW

TOTAL SAVINGS = 1808 KW @ $7.45/KW = $ 13,470

APPENDIX 2-12

75 H.P. AIR COMPRESSORS

COST SAVINGS CALCULATIONS

Previously two (2) 75 h.p. air compressors were left on during peak period to ensure proper air pressure. One 75 h.p. compressor is now shut off nearly all year. It is turned on only on rare occasions. It is replaced by a 40 h.p. compressor that runs intermittently. The cost of operating an air compressor is calculated in two ways:

- Demand Per Month
- Kilowatt Hour Consumption

However, we do not claim savings on demand. Since the 75 h.p. is used rarely, it is assumed that it is used during peak time. Therefore the cost savings are based on 12 months of the year on kilowatt hour consumption only.

COSTS

75 H.P. Compressor Motors:

$$KWH = \frac{600 \text{ Volts} \times 77 \text{ Amps} \times 1.73 \text{ (3 phase factor)}}{1{,}000 \text{ watts/kw}} \times 1 \text{ Hour}$$

= 79.9 KWH (90% Power Factor taken into this calculation)
@ 75% load (average) = 59.9 KWH

Costs:

- Consumption (KWH) = 59.9 KWH x $ .0275/KWH x 200 Hrs/Month
  = $ 329/Month

Total Cost/Month = $ 329

Cost/Year @ 12 Months = $ 329/Month x 12 Months = $ 3,948

40 H.P. Compressor:

$$KWH = \frac{600 \text{ Volts} \times 42 \text{ Amps} \times 1.73}{1{,}000 \text{ Watts/KW}} \times 1 \text{ Hours}$$

= 43.6 KWH
@ 75% Load
= 43.6 KWH x 75% = 32.7 KWH

Costs:

- Consumption (KWH) = 32.7 KWH x $ 0.0275/KWH x 200 Hrs/Month
  = $ 180/Month

Total Cost/Month = $ 180

Cost/Year = $ 180/Month x 12 Months/Year = $ 2,160/Year

SAVINGS

Assuming that the 40 h.p. runs continuously:

75 h.p Costs = $ 3,948/Year
LESS: 40 h.p. Costs = 2,160

TOTAL SAVINGS = $ 1,788/Year

APPENDIX 3

EQUIPMENT LIST - DETAIL

Appendix 3-1 = Equipment List
Appendix 3-2 = Installation - Detail
Appendix 3-3 = Allen Bradley PLC-2/30 Programmable Controller
Appendix 3-4 = Fans
Appendix 3-5 = Plate Heat Exchanger for Can Washer
Appendix 3-6 = Refrigeration - Heat Exchanger
Appendix 3-7 = Apple IIe

APPENDIX 3-1

EQUIPMENT LIST

1. HOT WATER RECOVERY SYSTEM

Monarch 4MT, H_2O Circulation Pump	$	558
Furnace Definite Purpose Contactors		400
Labour & Mat'l for Insulation of H_2O Storage Tank		2,758
Can Washer Spray Nozzles		228
1 Neptune Water Meter		376
1½" Crosby Pressure Relief Valve		113
1 Patterson-Kelly Refrigeration Heat Exchanger + Installation*		12,635
1 Patterson-Kelly Plate Heat Exchanger* (Can Washer)		5,500
SUB-TOTAL	$	22,568

2. HOT AIR RECOVERY SYSTEM

1 Magnetic Reversing Starter A50CG0A	$	261
9 Action E221 2-Wire Temperature Transmitters @ $ 277		2,493
9 Action E421 2-Wire Temperature Transmitters @ $ 223		2,007
8 RTD's 100 OHM @ $ 160		1,280
Ameteck Pressure Transducer & Signal Conditioner		675
18 Can Arm C54 Fans + Control @ $ 105		1,890
4 Aero Prop Propeller Fans*		5,625
SUB-TOTAL	$	14,231

3. ENERGY MANAGEMENT SYSTEM

1 Allen Bradley PLC 230 Programmable Controller*	$	39,513
1 Allen Bradley T3 Programming Terminal		4,395
6 Allen Bradley 1771 I/O Rack Structures @ $ 243		1,458
1 Allen Bradley KG Module		2,000
5 Allen Bradley 1771-1E Analog Module		4,060
1 Epsom MX80FT Dot Matrix Printer		1,450
1 Promac DHT820 Digial Calibrator		2,415
Lot of P.V.C. Conduit Pipe & Fittings		626
6 Relays Allen Bradley 700-P400A1		311
6 Condor Power Supplies		270
Current and Power Transformers (Lot)		120
5 Pyro Thermostats		356
Lot of Allen Bradley Instruction Manuals		140
20 A & B 1401-N10 Suppressors		375
Lot of Electrical Wire, Cable, Boxes, etc.		2,052
1 Allen Bradley 1772 LH Module		1,360
1 Allen Bradley 1772 ME Module		1,000
1 Allen Bradley 1772 SO Module		2,300
1 Allen Bradley 1770 RG Module		1,974
1 Allen Bradley 1770 RH Module		119
SUB-TOTAL	$	66,894

4. PEAK LOAD SHEDDING

2 Crompton Paladin KW Transducers @ $ 455		$ 910
2 Crompton Paladin Power Factor Transducer @ $ 429		858
Power Factor 24 Hour Recorder c/w Power Supply		1,165
Action TP640 Transmitter & ASP400 Pressure Transducer		890
	SUB-TOTAL	$ 3,823

5. COMPUTER INTERFACE

Apple IIe Plus 64 K*		$ 3,295
Language Card 16K		Inc
Disk Drive with Interface		Inc
2nd Disk Drive		535
Apple Monitor Stand		Inc
Apple III Monitor		Inc
Applewriter II (Word Processing)		Inc
Visicalc (Financial Modelling)		360
Apple 120 C.P.S. Printer		995
Apple with Interface		250
Apple with Cable		21
Three Boxes Diskettes (30)		179
Apple Business Graphics		102
Diskette Filing Box		50
6 Ribbons		15
2 Modems @ $ 200		400
1 Cable (modem to A-B PLC)		80
1 Cable (modem to Apple)		40
1 Apple Superserial Cord		275
Software Development (Interface)		2,000
Software Development (Data Analysis) (Surfline)		4,600
	SUB-TOTAL	$ 13,197
	TOTAL	$ 120,713

NOTES: * Specification sheet attached.

APPENDIX 3-2

INSTALLATION - DETAILS

WASTE HOT WATER RECOVERY

An insulated 5,000 gallon steel tank was installed along with the necessary piping to collect waste hot water from:

a) 4 Air Compressors
b) Boiler Continuous Blowdown
c) Boiler Oil Preheaters
d) Refrigeration System Heat Exchanger

A 450 gpm pump was installed on discharge line of waste heat recovery tank to equalize the tank temperature and to boost discharge pressure to a usable level.

CAN WASHER - HEAT RECOVERY

A 20 gpm plate type heat exchanger was installed on discharge of three (3) can washers. The discharged 65°C contaminated water flows from the can washers to a 20 gals/minute booster pump then through the heat exchanger to the sewer. The 10°C fresh water supply flows through the secondary circuit of heat exchanger then to the can washers.

CAN PLANT - RECIRCULATING FANS

A total of eighteen 54" circulating fans were suspended from the Can Plant ceiling. The eighteen units consisted of fifteen down draft and three up-draft fans. The down draft fans are used in areas requiring additional heat and the up-draft where heat dispensing is required.

The control system for the down draft fans consists of a ceiling temperature thermostat and a room thermostat. If the ceiling temperature is above 23°C and room temperature is below 20°C then the fans will run at a manually variable speed. The up-draft fans run continuously.

AIR FLOW CONTROL FANS

The plant air flow consists of five 10,000 CFM wall fans to transfer rather than exhaust hot air from warm areas to cooler plant areas. The fans are individually controlled by area temperatures utilizing the PLC 2/30.

ENERGY MONITORING

The electrical service is primary metered but is subdivided at the metering to supply No. 10 Plant complex and Connors facilities on the government wharf. It was therefore necessary to install one kilowatt transducer at each sub-service and a power factor transducer was installed at the No. 10 sub-service. The system KW demand, power factor and KVA demand are calculated by the PLC 2/30. A peak load shed and power factor correction program are then performed based on the above information.

APPENDIX 3-2 cont'd.

PLANT TEMPERATURE MONITORING

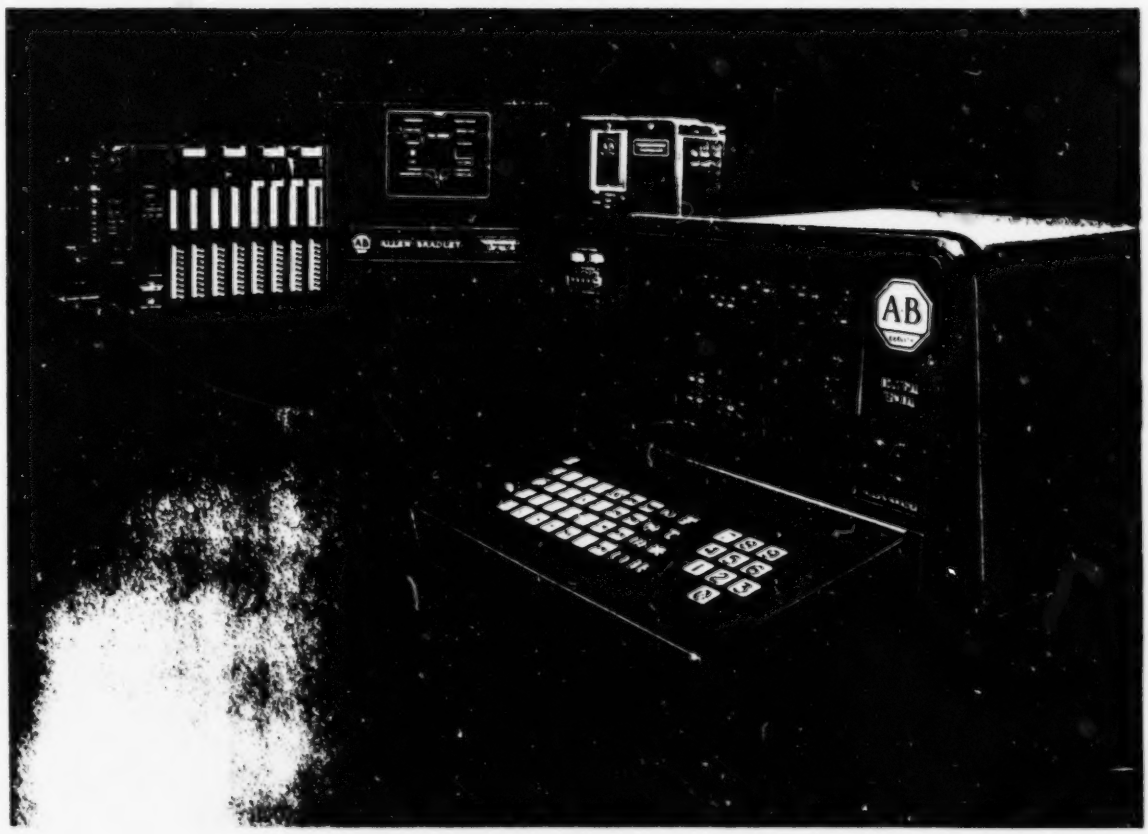
The air temperatures in all major plant areas are being monitored utilizing seventeen RTD's, either 0° to 100°C or -50° to 50°C range. The RTD's are mounted at ceiling level for protection from plant environment. All temperatures are recorded by the PLC 2/30.

RECOVERED HOT WATER TEMPERATURE MONITORING

The recovered hot water temperature is monitored using a low temperature, -50° to 50°C, RTD installed in the waste heat recovery tank recirculation line. The temperature is recorded by PLC 2/30.

Bulletin [illegible]

[illegible] Terminal Systems



UNIVERSAL — the SYSTEM can be used with the complete Family of Allen-Bradley Programmable Controllers.

RUGGED — designed for most industrial environments.

[illegible] — designed to be readily "enhanced" for new product compatibility.

[illegible] — can serve as programming terminal and "communication console."

System description

The Allen Bradley Bulletin 1770 INDUSTRIAL TERMINAL SYSTEMS are intelligent Cathode Ray Tube (CRT) terminals that will interface with existing and future A-B Programmable Controllers (PCs), and the Series 7100 Computerized Numerical Control (CNC). The INDUSTRIAL TERMINAL SYSTEM (Cat. No. 1770-T1) will interface with the Bulletin 1772 PLC-2, PLC-2/20, and Mini PLC-2 Programmable Controllers, and the Series 7100 CNC. The INDUSTRIAL TERMINAL SYSTEM (Cat. No. 1770-T2) will interface with the Bulletin 1774 PLC Programmable Controller as well as those A-B products listed for the 1770-T1 INDUSTRIAL TERMINAL SYSTEM. Both SYSTEMS will function as the programming terminal for their respective A-B products and also as a general purpose ASCII (alphanumeric) data terminal. Using existing Allen Bradley PC programming knowledge, the Industrial Terminal System makes programming Allen-Bradley Programmable Controllers even easier than before.

Weighing less than 45 pounds, the Industrial Terminal System is lightweight, portable and easily carried yet rugged enough to withstand most industrial environments (0° - 55°C). It can be used in its normal desktop position or standing on end for use out on the shop floor or in close quarters where a desk or table is not available.

The detachable sealed touchpad keyboard with multiple color coded keytop overlays makes the Industrial Terminal System a universally compatible programming terminal for programming Allen-Bradley PCs. A beep tone is generated when a valid key on the keyboard is pressed.

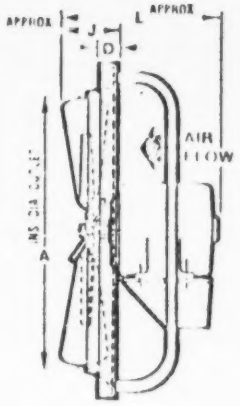
PC program instructions for loading, editing and monitoring a ladder diagram program in memory are entered through the keyboard and monitored on the Industrial Terminal's CRT. These program instructions are in the form of symbols similar to the familiar relay characters. ASCII report messages can also be generated from the keyboard, as well as received and displayed on the screen.

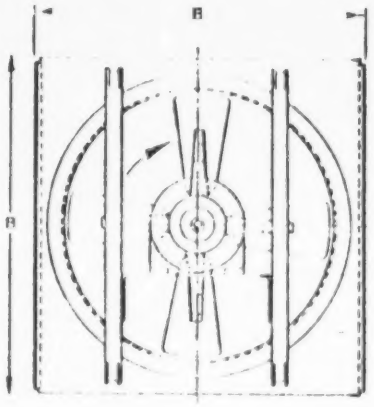
Industrial Terminal with PLC Keytop Overlay

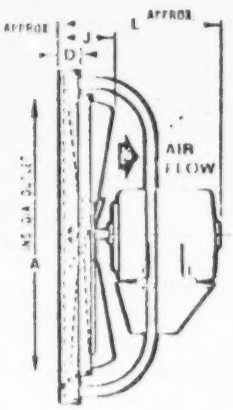
AEROFOIL PROP dimensions

arrangement 4 direct drive

CHANNEL ARM – STD. FLOW

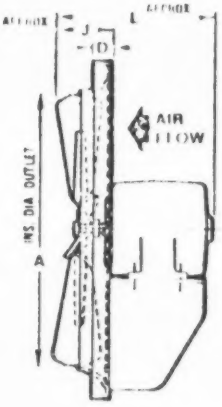


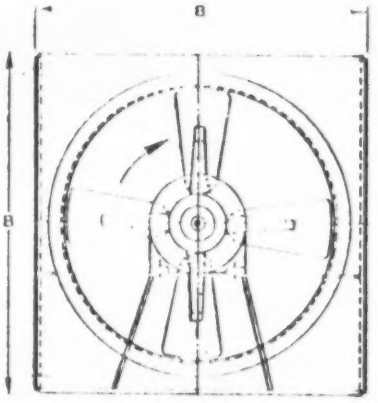




CHANNEL ARM – REV. FLOW

PLATE ARM – STD. FLOW





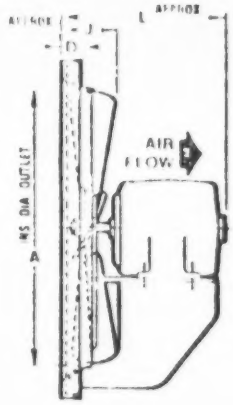


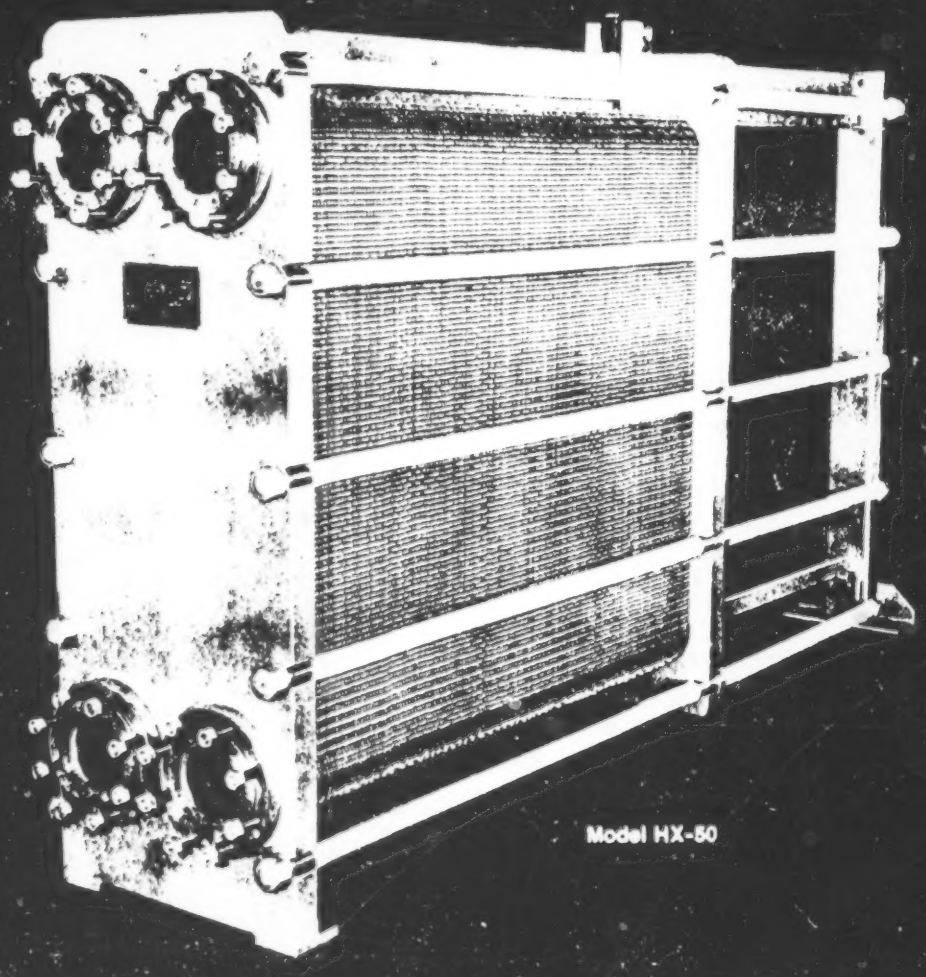
PLATE ARM – REV. FLOW

SIZE	A	B	D	J	CHANNEL ARM MV STD	CHANNEL ARM MV REV	CHANNEL ARM MD STD	CHANNEL ARM MD REV	PLATE ARM MV STD	PLATE ARM MV REV	PLATE ARM MD STD	PLATE ARM MD REV
24"	24-1/2	30-1/2	2	5-3/8	18-3/4	21-1/8	19	18-1/8	–	–	–	–
30"	30-5/8	38	2	6	20-5/8	23-5/8	19-3/4	20-3/8	–	–	–	–
36"	36-3/4	44	2	6-5/8	25-1/2	27-5/8	25	25	–	–	–	–
42"	42-3/4	49	1-1/2	7-1/8	27-1/2	29-5/8	25-1/2	26-3/4	27-1/2	29-5/8	25-1/2	26-3/4
48"	48-3/4	55	1-1/2	7-1/2	28	29-5/8	28-1/8	26-5/8	28	29-5/8	28-1/8	26-5/8
54"	54-3/4	61	1-1/2	8-1/8	31	32-7/8	29-1/4	29-1/4	31	32-7/8	29-1/4	29-1/4
60"	61-1/4	69	2	8-5/8	29-1/4	29-1/4	29-1/4	29-1/4	32	32	34-1/4	34-1/4
66"	67-3/4	75-1/2	2	9-7/8	–	–	–	–	35-1/4	35-1/4	37-1/2	37-1/2
72"	73-1/2	81-1/2	2	10-1/4	–	–	–	–	37-5/8	37-5/8	37-3/4	37-3/4

* J & L listed are maximum dimensions.
Exact dimensions are supplied on certified prints upon request.

N. B. Sales and Service
22 Germain St.
Saint John, N. B. E2L 2E5
Tel. 652-5310

P-K System ReHeat Plate Heat Exchangers



PATTERSON-KELLEY CO.

P-K System ReHeat Plate Heat Exchanger

The P-K System ReHeat Model HX plate heat exchanger complements our broad line of heat transfer products and enables us to meet the requirements of virtually any liquid heating and cooling application.

Our Model HX plate exchanger recovers maximum energy. This makes it ideal for a wide range of energy conservation applications involving small temperature differences, temperature crossings and close temperature approaches. In addition, it achieves economical use of alloys, such as stainless steel, titanium and other corrosion-resistant metals.

Custom-Designed with Standard Components

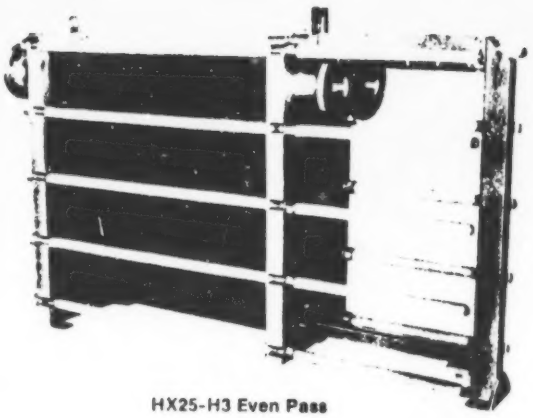
Our plate heat exchangers are custom designed with standard components. For example, each model comes in several frame sizes using standard-size pressure covers, piping connections and heat transfer plates. This reduces costs, speeds delivery and gives you the flexibility to increase capacity or to modify the unit for a new thermal duty if your requirements change. Frames can also be custom designed on request for special applications.

Computerized Selection

In selecting the type of heat exchanger for your application, our engineers analyze and evaluate your design requirements. Temperatures, flow variables, turbulence, fluid-fouling factors, pressure drops and other pertinent data are fed through our computer to quickly arrive at the heat exchanger that will perform best plus provide minimum maintenance. It could be a plate exchanger or a shell-and-tube unit. In any case, you come out ahead. You get the engineering know-how and quality of construction that have been going into P-K heat transfer equipment for over 95 years.

ASME Construction

Standard models of P-K System ReHeat plate heat exchangers are constructed and stamped in accordance with Section VIII of the ASME Code for working pressures from 100 psig to 250 psig, have National Board Registration and an insurance company certificate of inspection. Available as an option are units constructed to ASME Code, Section III, Class 3, for nuclear service.



HX25-H3 Even Pass

P-K Guarantee

Patterson-Kelley Company guarantees all materials and workmanship used in the construction of P-K Model HX plate heat exchangers to be the highest quality. We further guarantee each plate heat exchanger to operate at its rated capacity. If any part should prove defective within one year, a new part will be supplied without charge, f.o.b. East Stroudsburg, Pennsylvania.

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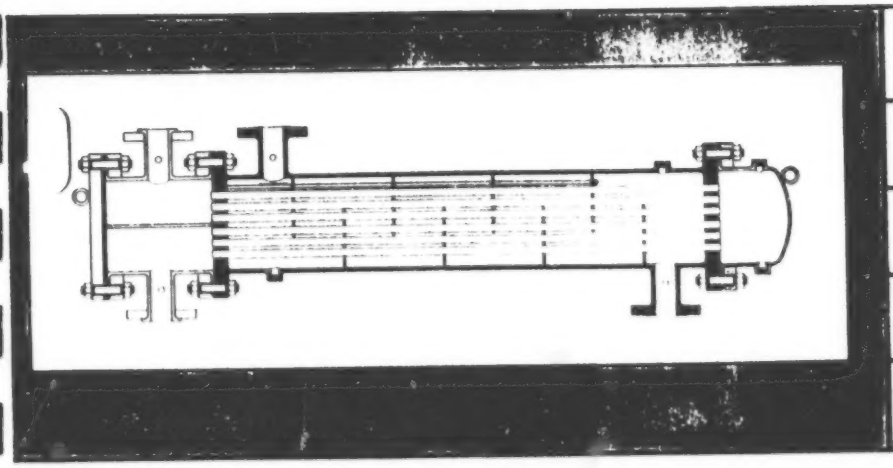
East Stroudsburg, Pennsylvania 18301

Specifications and descriptions herein are in effect when this publication was approved for printing. Patterson-Kelley reserves the right to discontinue models or options of any kind at any time. Improvements in design, equipment or designs without notice and without incurring any obligation.

BULLETIN NO. 700-A2
REPRINTED FROM P-K HEAT EXCHANGER MANUAL NO. 700-A

[illegible] exchanger

[illegible]gn information



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2	COMPONENT NOMENCLATURE
4	SHELL AND HEAD COMBINATIONS
12	SHELL AND HEAD CODING INDEX
16	DESIGN FEATURES

PATTERSON-KELLEY CO.
Division of HARSCO Corporation
EAST STROUDSBURG, PENNSYLVANIA 18301

Shell-and-tube and plate heat exchangers • steam generators • fractionating trays • pressure vessels • process packages • cooling towers • water heaters • blenders • dryers • corrosion-resistant cements

The following designs are illustrated only for the purpose of establishing component identification and standard terminology for P-K heat exchangers.

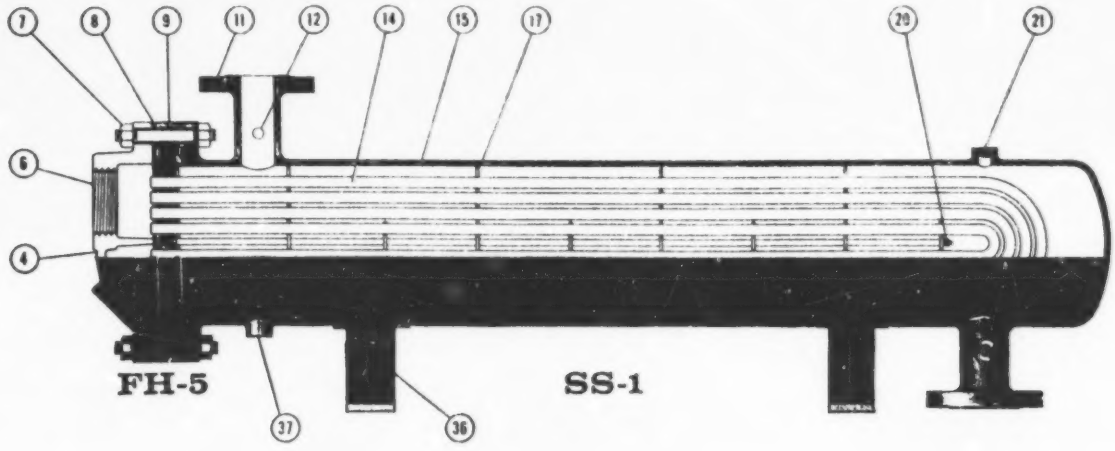

FIG. 1

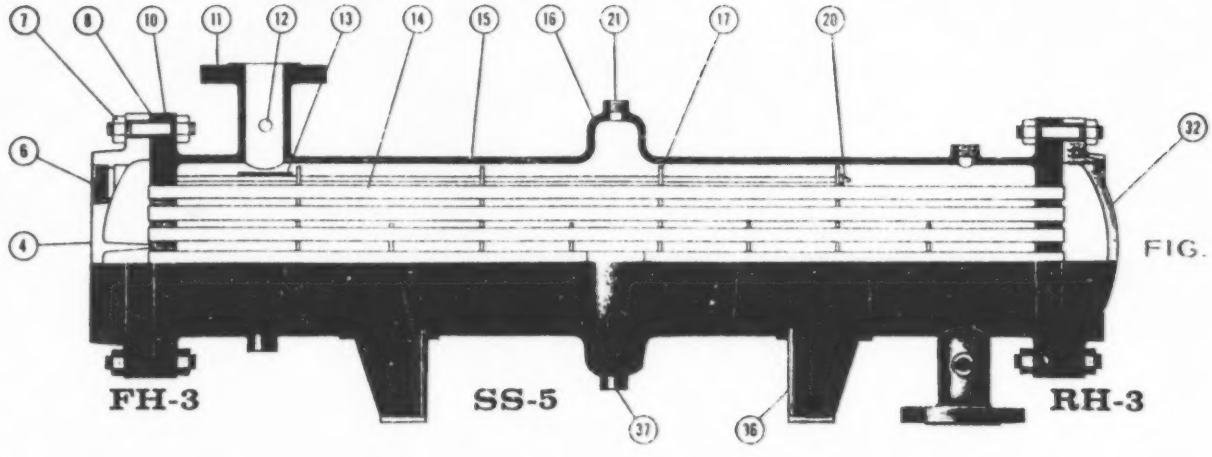

FIG. 2

component nomenclature

1—Channel Cover
2—Channel
3—Channel Nozzle
4—Bonnet
5—Bonnet Nozzle
6—Bonnet Connection
7—Bolting
8—Gasket
9—Stationary Tubesheet
10—Fixed Tubesheet
11—Shell Nozzle
12—Test Connection
13—Impingement Baffle
14—Tube
15—Shell
16—Expansion Joint
17—Transverse Baffle
18—Support Plate
19—Longitudinal Baffle
20—Tie Rod and Spacer
21—Vent Connection
22—Split Backing Flange
23—Floating Tubesheet
24—Floating Head Reversing Bonnet
25—Lantern-Ring
26—Packing
27—Stuffing Box
28—Gland
29—Floating Tubesheet and Skirt
30—Key Ring Flange
31—Split Key Ring
32—Reversing Bonnet
33—Floating Head Cover Plate
34—Shell Cover
35—Lifting Ring
36—Support Cradle
37—Drain Connection

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